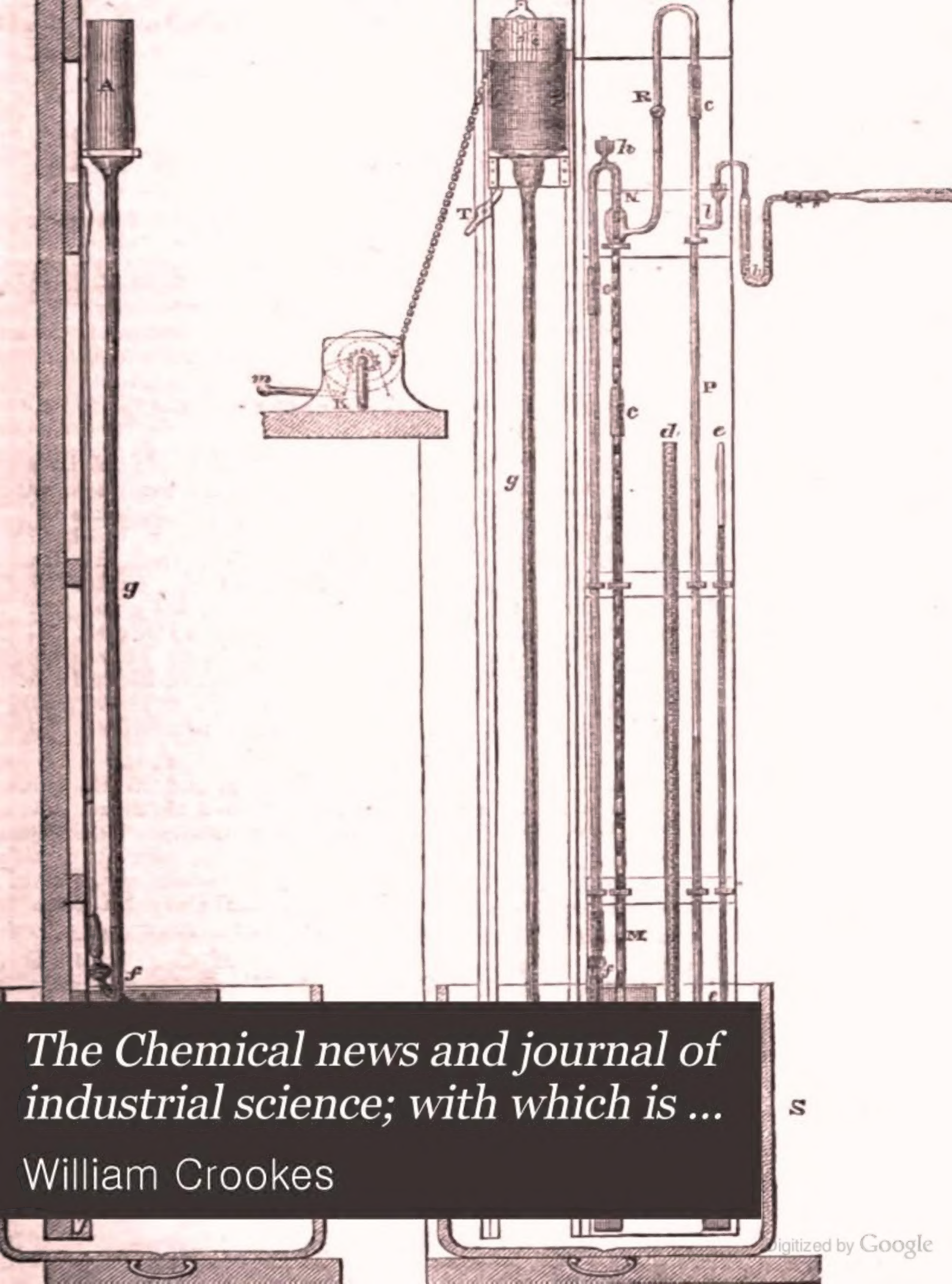

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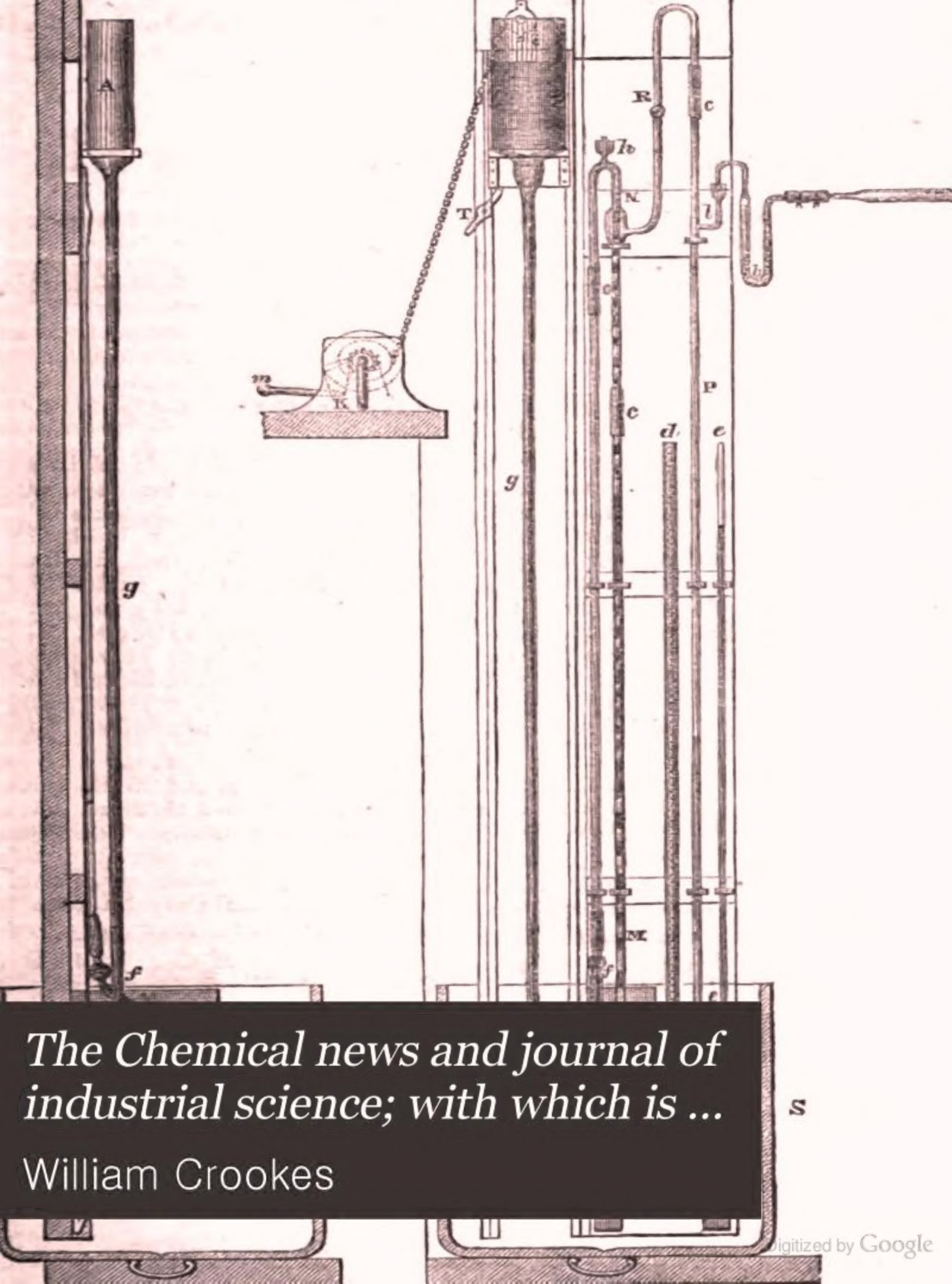

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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

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THE CHEMICAL NEWS.

VOLUME XXIX.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 736.—FRIDAY, JANUARY 2, 1874.

ON THE ACTION OF HEAT ON GRAVITATING MASSES.[*]

By WILLIAM CROOKES, F.R.S., &c.

The experiments recorded in this paper have arisen from observations made when using the vacuum-balance, described by the author in his paper "On the Atomic Weight of Thallium,"[†] for weighing substances which were of a higher temperature than the surrounding air and the weights. There appeared to be a diminution of the force of gravitation, and experiments were instituted to render the action more sensible, and to eliminate sources of error.

In an historical *résumé* of the state of our knowledge on the subject of attraction or repulsion by heat, it is shown that in 1792 the Rev. A. Bennet recorded the fact that a light substance delicately suspended in air was attracted by warm bodies: this he ascribed to air-currents. When light was focused, by means of a lens, on one end of a delicately suspended arm, either in air or in an exhausted receiver, no motion could be perceived distinguishable from the effects of heat.

Laplace speaks of the repulsive force of heat. Libri attributes the movement of a drop of liquid along a wire heated at one end, to the repulsive force of heat; but Baden Powell has not succeeded in obtaining evidence of repulsion by heat from this experiment.

Fresnel describes an experiment by which concentrated solar light and heat caused repulsion between one delicately suspended and one fixed disk. The experiment was tried in air of different densities, but contradictory results were obtained, under apparently similar circumstances, at different times, and the experiments were not proceeded with.

Saigey describes experiments which appear to prove that a marked attraction exists between bodies of different temperatures.

Forbes, in a discussion and repetition of Trevelyan's experiment, comes to the conclusion that there is a repulsive action exercised in the transmission of heat from one body into another which has a less power of conducting it.

Baden Powell, repeating Fresnel's experiment, explains the results otherwise than as due to repulsion by heat. By observing the *descent* of the tints of Newton's Rings between glass-plates when heat was applied, Dr. Powell shows that the interval between the plates increases, and attributes this to a repulsive action of heat.

Faye has introduced the hypothesis of a repulsive force of heat to account for certain astronomical phenomena. He describes an experiment to show that heat produces repulsion in the luminous arc given by an induction-coil in rarefied air.

The author describes numerous forms of apparatus successively more and more delicate, which enabled him to detect, and then to render very sensible, an action exerted by heat on gravitating bodies, which is not due to air-currents, or to any other known force.

The following experiment with a balance made of a straw beam with pith-ball masses at the ends enclosed in a glass tube, and connected with a Sprengel pump, may be quoted from the paper:—

"The whole being fitted up as here shown, and the apparatus being full of air to begin with, I passed a spirit-flame across the lower part of the tube at *b*, observing the movement by a low-power micrometer; the pith-ball (*a*, *b*) descended slightly, and then immediately rose to considerably above its original position. It seemed as if the true action of the heat was one of attraction, instantly overcome by ascending currents of air. . . . .

"31. In order to apply the heat in a more regular manner, a thermometer was inserted in a glass tube, having at its extremity a glass bulb, about 1¼ inch diameter; it was filled with water, and then sealed up. . . . The water was kept heated to 70° C., the temperature of the laboratory being about 15° C.

"32. The barometer being at 767 millims., and the gauge at zero, the hot bulb was placed beneath the pith-ball at *b*. The ball rose rapidly; as soon as equilibrium was restored, I placed the hot-water bulb above the pith-ball at *a*, when it rose again, more slowly, however, than when the heat was applied beneath it.

"33. The pump was set to work, and when the gauge was 147 millims. below the barometer, the experiment was tried again; the same result, only more feeble, was obtained. The exhaustion was continued, stopping the pump from time to time, to observe the effect of heat, when it was seen that the effect of the hot body regularly diminished as the rarefaction increased, until when the gauge was about 12 millims. below the barometer the action of the hot body was scarcely noticeable. At 10 millims. below it was still less; whilst when there was only a difference of 7 millims. between the barometer and the gauge, neither the hot-water bulb, the hot rod, nor the spirit-flame caused the ball to move in an appreciable degree. The inference was almost irresistible that the rising of the pith was only due to currents of air, and that at this near approach to a vacuum the residual air was too highly rarefied to have power in its rising to overcome the inertia of the straw beam and the pith balls. A more delicate instrument would doubtless show traces of movement at a still nearer approach to a vacuum; but it seemed evident that when the last trace of air had been removed from the tube surrounding the balance (when the balance was suspended in empty space only), the pith-ball would remain motionless wherever the hot body were applied to it.

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[*] Abstract of a Paper sent to the Royal Society August 12, 1873.

[†] *Phil. Trans.*, 1873, vol. clxiii., part 1, p. 277.

"34. I continued exhausting. On next applying heat, the result showed that I was far from having discovered the law governing these phenomena; the pith-ball rose steadily, and without that hesitation which had been observed at lower rarefactions. With the gauge 3 millims. below the barometer, the ascension of the pith when a hot body was placed beneath it was equal to what it had been in air of ordinary density; whilst with the gauge and barometer level its upward movements were not only sharper than they had been in air, but they took place under the influence of far less heat; the finger, for example, instantly sending the ball up to its fullest extent."

A piece of ice produced exactly the opposite effect to a hot body.

Numerous experiments are next given to prove that the action is not due to electricity.

The presence of air having so marked an influence on the action of heat, an apparatus was fitted up in which the source of heat (a platinum spiral rendered incandescent by electricity) was inside the balance-tube instead of outside it as before; and the pith-balls of the former apparatus were replaced by brass balls. By careful management, and turning the tube round, the author could place the equipoised brass pole either over, under, or at the side of the source of heat. With this apparatus it was intended to ascertain more about the behaviour of the balance during the progress of the exhaustion, both below and above the point of no action, and also to ascertain the pressure corresponding with this critical point.

After describing many experiments with the ball in various positions in respect to the incandescent spiral, and at different pressures, the general result appeared to be expressed by the statement that the tendency in each case was to bring the centre of gravity of the brass ball as near as possible to the source of heat, when air of ordinary density, or even highly rarefied, surrounded the balance. The author continues:—

"44. The pump was then worked until the gauge had risen to 5 millims. of the barometric height. On arranging the ball above the spiral (and making contact with the battery), the attraction was still strong, drawing the ball downwards a distance of 2 millims. The pump continuing to work, the gauge rose until it was within 1 millim. of the barometer. The attraction of the hot spiral for the ball was still evident, drawing it down when placed below it, and up when placed above it. The movement was, however, much less decided than before; and in spite of previous experience (33, 34) the inference was very strong that the attraction would gradually diminish until the vacuum was absolute, and that then, and not till then, the neutral point would be reached. Within one millimetre of a vacuum there appeared to be no room for a change of sign.

"45. The gauge rose until there was only half a millimetre between it and the barometer. The metallic hammering heard when the rarefaction is close upon a vacuum commenced, and the falling mercury only occasionally took down a bubble of air. On turning on the battery current, there was the faintest possible movement of the brass ball (towards the spiral) in the direction of *attraction*.

"46. The working of the pump was continued. On next making contact with the battery no movement could be detected. The red-hot spiral neither attracted nor repelled; I had arrived at the critical point. On looking at the gauge I saw it was level with the barometer.

"47. The pump was now kept at full work for an hour. The gauge did not rise perceptibly, but the metallic hammer increased in sharpness, and I could see that a bubble or two of air had been carried down. On igniting the spiral, I saw that the critical point had been passed. The sign had changed, and the action was faint but unmistakable *repulsion*. The pump was still kept going, and an observation was taken from time to time during several hours. The repulsion continued to increase. The tubes of the pump were now washed out with oil of vitriol,* and the working was continued for an hour.

"48. The action of the incandescent spiral was now found to be energetically *repellent*, whether it was placed above or below the brass ball. The fingers exerted a repellent action, as did also a warm glass rod, a spirit-flame, and a piece of hot copper."

In order to decide once for all whether these actions really were due to air-currents, a form of apparatus was fitted up, which, whilst it would settle the question indisputably, would at the same time be likely to afford information of much interest.

By chemical means a vacuum was obtained in an apparatus so nearly perfect that it would not carry a current from a Ruhmkorff's coil when connected with platinum wires sealed into the tube. In such a vacuum the repulsion by heat is decided and energetic.

An experiment is next described, in which the rays of the sun, and then the different portions of the solar spectrum, are projected into the delicately suspended pith-ball balance. *In vacuo* the repulsion is so strong as to cause danger to the apparatus, and resembles that which would be prodcued by the physical impact of a material body.

Experiments are next described in which various substances are used as the gravitating masses. Amongst these are ivory, brass, pith, platinum, gilt pith, silver, bismuth, selenium, copper, mica, (horizontal and vertical), charcoal, &c.

The behaviour of a glass beam with glass ends in a chemical vacuum, and at lower exhaustion, is next accurately examined, when heat is applied in different ways.

On suspending the light index by means of a cocoon fibre in a long glass tube, furnished with a bulb at the end, and exhausting in various ways, the author finds that the attraction to a hot body in air, and the repulsion from a hot body *in vacuo*, are very apparent.

Speaking of Cavendish's celebrated experiment, the author says that he has experimented for some months on an apparatus of this kind, and gives the following outline of one of the results he has obtained:—

"A heavy metallic mass, when brought near a delicately suspended light ball, attracts or repels it under the following circumstances.

"I. *When the ball is in air of ordinary density.*
- *a.* If the mass is *colder* than the ball, it *repels* the ball.
- *b.* If the mass is *hotter* than the ball, it attracts the ball.

"II. *When the ball is in a vacuum.*
- *a.* If the mass is *colder* than the ball, it *attracts* the ball.
- *b.* If the mass is *hotter* than the ball, it *repels* the ball."

The author continues:—"The density of the medium surrounding the ball, the material of which the ball is made, and a very slight difference between the temperatures of the mass and the ball, exert so strong an influence over the attractive and repulsive force, and it has been so difficult for me to eliminate all interfering actions of temperature, electricity, &c., that I have not yet been able to get distinct evidence of an independent force (not being of the nature of heat) urging the ball and the mass together.

"Experiment has, however, showed me that, whilst the action is in one direction in dense air, and in the opposite direction in a vacuum, there is an intermediate pressure at which differences of temperature appear to exert little or no interfering action. By experimenting at this critical pressure, it would seem that such an action as was obtained by Cavendish, Reich, and Baily, should be rendered evident."

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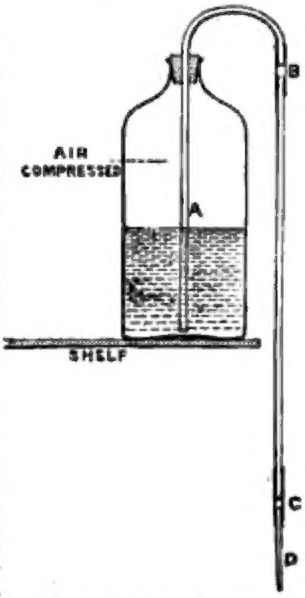
* This can be effected without interfering with the exhaustion.

After discussing the explanations which may be given of these actions, and showing that they cannot be due to air-currents, the author refers to evidences of this repulsive action of heat, and attractive action of cold, in Nature. In that portion of the sun's radiation which is called heat, we have the radial repulsive force possessing successive propagation required to explain the phenomena of comets and the shape and changes of the nebulæ. To compare small things with great (to argue from pieces of straw up to heavenly bodies), it is not improbable that the attraction now shown to exist between a cold and a warm body will equally prevail when, for the temperature of melting ice is substituted the cold of space, for a pith ball a celestial sphere, and for an artificial vacuum a stellar void. In the radiant molecular energy of cosmical masses may at last be found that "agent acting constantly according to certain laws," which Newton held to be the cause of gravity.

CHEMICAL REAGENTS.

By R. H. RIDOUT.

In chemical analysis, where small quantities of the reagent are wanted frequently, much time is lost in taking the stoppers out of the bottles, and then, no matter what care may be exercised, there is always a small quantity of the reagent left to evaporate on the rim of the neck of the bottle, and many reagents which are deteriorated by exposure to the air have to be prepared only in small quantities. To obviate these petty annoyances, I have adopted the following plan with the best results:—



The bottles to contain the reagents are about two or more times the size of the bottles in which they are ordinarily contained. A is a bottle having a glass tube passing through a first-rate cork in the narrow neck. The end of the tube in the bottle is within about ¼ inch of the bottom; the other end makes a complete arch, and is connected to the glass tube, BC, by an india-rubber junction. D is a fine glass jet, fixed also to BC by an india-rubber junction, the ends of the tubes being just far enough apart to allow a pinch-cock to be placed on the india-rubber tube. The reagent is placed in a wash-bottle, its jet being connected to the jet B by an india-rubber tube. A bladder is attached to the mouth-piece, and the liquid forced up CB into the bottle, thereby compressing that air in the bottle above the reagent. The pinch-cock being put up in C, the reagent is prevented escaping. When the pinch-cock is opened, the air on the surface of the liquid A will force it through the tubes and out of the jet D drop by drop, or in a rapid stream, as may be desired.

It will be seen that the liquid never comes into contact with any air except that in the bottle, and this may either be purified from harmful compounds, or another gas substituted having no action upon the liquid.

The india-rubber junction prevents its application to strong acids, but by far the greater number of reagents are unaffected by one form or another.

Monmouth, Nov. 28, 1873.

FOOD ANALYSIS:

I. NOTE ON THE ESTIMATION OF FAT IN MILK.

By J. ALFRED WANKLYN.

It is well known that some difficulty has been experienced in making a complete extraction of the fat which exists in milk. This difficulty appears to arise partly from the presence of water, which appears to protect the fat from the action of the ether; and, in order to effect a complete extraction, it appears to be necessary first to get rid of the water of the milk by evaporation, and then to boil the dry residue repeatedly with ether.

Since the publication of my recent "Manual of Milk-"Analysis, I have adopted a very convenient form of apparatus for carrying out these and analogous extractions; and, although the device is apparently trifling, it may possibly be of service to describe it at the present time.

The operations are first of all the drying up of a small quantity of milk, and afterwards the boiling of the residue with ether; and a vessel, which is alternately an evaporating basin and a flask, is exactly that which is called for.

These conditions are fulfilled as follows:—A thin platinum dish, capable of holding about 50 c.c. is employed, and in it the portion of milk (5 or 10 c.c. accurately measured), is evaporated to dryness. The dish, during this evaporation, is heated in the water-bath, which consists simply of a beaker half-filled with water which is boiled over the lamp. The milk, as it is being evaporated, may be stirred up with a small glass rod, or small platinum spatula. The milk-residue having been obtained in a state of tolerable dryness, it is covered with 20 or 30 c.c. of ether, and a *small inverted funnel* is fitted moderately tightly into the platinum dish, which is thereby converted into a flask. The further details are obvious.

By the adoption of this apparatus, the determination of the fat in milk becomes perfectly easy.

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE

MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Concluded from page 392).

The amount of steam converted into visible vapour, and cause of excessive loss of power in ordinary steam-engines may be made clear in this way. There is in the receiver of the air-pump a piece of sponge with a little water on it; if a portion of the air saturated with vapour be pumped out, a small portion of the water is converted into vapour, which you see deposited in a film on the glass. This is caused by the air being rarefied, and becoming colder, therefore not competent to hold in solution as much vapour as it had previously done. Now, what takes place in this receiver is taking place in hundreds of steam-engine cylinders, and wasting pounds and pounds of fuel. As soon as the steam enters the cylinder it fills it, or rather it fills the part of the cylinder below the piston. Arrangements are usually made that a portion of the stroke may be accomplished by the expansive action of the steam. Now, as soon as the opportunity for expansion is presented, there is at once this deposit of moisture, and the deposit is indicative of a sacrifice of heat.

Now, this action of heat is not confined to liquids, it also extends to solids. Here is a piece of unannealed glass. Those present who have to deal with steam-engines, know that it very often happens from some apparently unaccountable cause, that what are called the water-gauges of the boilers are broken. These breakages are in consequence of the glass tubes being unannealed; and if you are aware of the process by which tubes are made, you will see at once they cannot, without some special arrangements, be annealed. They are made by taking a solid ball of glass out of the pot; this is then blown into a globe; then a second man puts a pipe with a molten nodule of glass upon it on that part of the globe which is opposite to the pipe by which it was blown. The men run asunder, and so the globe is lengthened out into a tube and laid along the floor. This long pipe is then cut into gauge-tube lengths, and generally so sold. If one of these tubes be cleaned with an iron wire, having a piece of cotton-wool wrapped round it, the wire being pushed up and down as is usually done, and the clean tube be restored to the boiler, it may, in two or three days or weeks, fall to pieces without any one being to blame, except those who put the wire through the tube. Here is a piece of glass very thick and strong, and in all respects very good glass, but unannealed. It is really a simple piece taken out of the melting-pot as a sample, to guide the manufacturer respecting the quality and colour of the articles that may be made from it. Now, in all probability, if this piece of quartz, less than the size of an ordinary pea, be allowed to drop gently into the sample flask, this strong flask (the glass is nearly one-half of an inch in thickness) may fall into pieces. There! You see the bottom has immediately dropped out, notwithstanding the thickness, and if it were left here all night it might crumble into half-a-dozen pieces before the morning. On one occasion I cleaned out a glass tube, about three feet long, connected with an air-pump, and in a thoughtless moment took a wire, attached some cotton-wool to it, and drew it through the tube. In about half an hour there was a slight click—in a few minutes another click. On looking at the tube it was seen to be cracked. The slight but instructive noises continued, click after click, and crack after crack, and in the morning the tube was separated into many hundred pieces, though no one touched it. Workmen and servants are often blamed for the breakage of glass, which breakage arises from such a cause as this.

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* The Cantor Lectures delivered before the Society of Arts.

What are called Prince Rupert's drops are obtained by allowing molten glass to fall into water, and so falling, the drops are suddenly cooled on the outside, and the consequence is that the molten glass in the interior is firmly bound beyond its power of resistance, even though it has a large amount of heat in it. If it had been free, the molecules of glass would have crystallised, and arranged themselves according to the law which governs them; but being bound by the external film they cannot so arrange themselves. The heat contained in them cannot do the works of crystallisation it was competent to do—it has become stored up or potential. Therefore, as soon as ever the equilibrium of the shell of the bulb is destroyed this heat gives out its work. In the interior of this bulb there is a large amount of potential energy; and if the equilibrium be destroyed by cracking off the end, in the same way as it was destroyed in the other case by dropping a little bit of quartz into the thick glass, we shall find it will manifest itself, and very possibly will break the glass bottle in which the Rupert's drop is placed.

We will now pass on to a series of experiments, the object of which is to show the effect of heat in relation to solids and liquids, and converting them into vapour. Mr. Wills, to whom we were indebted for assistance on the evening of the lecture on the energy of affinity, has kindly undertaken to exhibit some striking and instructive experiments. In this iron bottle there is condensed carbonic acid gas, which under ordinary circumstances is a gas, but when it is brought under a pressure of 700 lbs. to the square inch it becomes a liquid. To re-convert it from liquid into gas requires a large amount of heat. The consequence is, one part takes heat from the other, whilst a portion of it is sent forward in the form of vapour at the expense of the heat of the remainder. That remainder, therefore, becomes colder and colder, and appears in the form of ice and snow, as you see on turning the tap, and letting it escape into the room. The white substance which now is falling in the room is carbonic acid snow. There is an apparatus for enabling the vapour to pass round and round in a copper vessel, and then escape at the handles; in so doing it absorbs a large quantity of heat, and therefore that which remains in the vessel freezes. We shall collect in this way a large amount of snow, which can afterwards be used for other purposes. Nearly a pound weight of this carbonic snow is now deposited in the copper vessel, and so cold is it, that, on wrapping a piece of wet flannel round the vessel, it freezes immediately. This snow can be held lightly in the hand without inconvenience, but if pressed a blister will at once be raised. Mr. Wills has taken a small portion upon his tongue, and breathing out the vapour as it melts, a candle is immediately extinguished. In the same way some of it may be put in a beaker, and the gas collected as the snow melts, when it will be found that a light cannot live in it. Again, here is a bottle of water; by putting some carbonic snow into it, and corking it up, we immediately get excellent soda-water. By pouring some ether upon it, the degree of cold is greatly increased by the rapid evaporation, so that the vessel becomes frozen to the stool upon which it stands, and a pound or two of mercury will soon be frozen into a solid body. The temperature is about 130° below the freezing-point. On placing the frozen mercury at the top of a tall jar of water, beautiful icicles are immediately formed in consequence of the intense cold.

Before closing, attention may be directed to the sources whence our supplies of heat are derived. The classification of these, and the character of the heat derived from them, may be studied in the tabular form.

Sources.

A	Inherent Affinities.
B	Solar Radiation.
C	Earth's Rotation.
D	Earth's Internal Heat.

Stores.

Potential.	Whence Derived.
Fuel	B and A.
Food	B.
Reservoir Water	B.
Tidal Water	C.

Kinetic.	Whence Derived.
Winds	B.
Ocean Currents	B.
Hot Springs	D.
Volcanoes	D.

There is one other matter to which the subject of last week's lecture bears a very extraordinary relation. Science investigations have established that a process of what is called dissipation of energy is going on. In the lecture on the energy of light, attention was directed to a remarkable testimony which, through modern science views, is thus given to Scripture. Let me add a few words on an equally remarkable one in reference to the energy of heat. In the case of light, page 699, reference was made to the beginning of the Bible; in this case of heat it is to the end of it. St. John (Rev., vii., 16), speaking of the new heavens, writes, "Neither shall the sun light on them nor any heat." How singularly in accord with this is the declaration (Rev., xxi., 1), "There shall be no more sea, neither shall they thirst any more." Clearly, if the heat be not, there can be no water nor sea. Now, science testifies to the dissipation of heat, and thus unconsciously testifies to a gradual progress to that state which prophecy so plainly declares.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 18th, 1873.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. Arthur William Waters, F.G.S., Professor Arthur Gamgee, F.R.S., and Mr. Arthur Schuster, Ph.D., were elected Ordinary Members of the Society.

"*On the Bursting of Trees and Objects struck by Lightning*," by Professor Osborne Reynolds, M.A. In a paper on this subject read at the last meeting of this society I stated that the tube which was burst by a discharge from a jar would probably withstand an internal pressure of from 2 to 5 tons on the square inch; and I made use of the expression the tube might be fired like a gun without bursting. These statements were based on the calculated strength of the tube, and with a view to show that there was no mistake, I have since tried it in the following manner. I made three guns of the same tube. No. 1, which was 6 inches long, had its end stopped with a brass plug containing the fuze hole. Nos. 2 and 3 were 6 inches long and had their breeches drawn down so as only to leave a fuze hole. These tubes were loaded with gunpowder and shotted with slugs of wire which fitted them, and which were all ¾ inch long. No. 1 was first fired with ½ inch of powder, the shot penetrated ½ inch into a deal board, and the gun was uninjured. No. 2 was then fired with 1¼ inches of powder, and the shot went through the 1 inch deal board and ¼ inch into some mahogany behind, thus penetrating altogether 1¼ inches; the tube, however, was burst to fragments. Some of these were recovered, and although they were small they did not show cracks and signs of crushing like those from the electrical fracture. No. 3 was then fired with ¾ inch of powder, and the shot penetrated ½ inch into the deal board. It was again fired with one inch of powder, and the shot penetrated 1 inch into the deal. Again it was a third time fired with 1¼ inches of powder, when it burst, and the shot only just dented the wood. These experiments seem to me to prove conclusively the great strength of the tube and the enormous bursting force of the electrical discharge.

"*On the Colour of Nankin Cotton*," by Edward Schunck, Ph.D., F.R.S.—Among the numerous varieties of cotton existing in commerce there is one which cannot fail to strike the most unpractised eye, in consequence of the peculiar colour, varying from a pale yellow or rather fawn to a brown, or reddish-brown which it exhibits. This kind of cotton is generally called "Nankin" cotton in consequence of its having been used at an early period by the Chinese for the manufacture of the fabric called nankin or nankeen, the peculiar colour of which is so well known as to need no description. Specimens of raw cotton of the colour referred to from other countries, such as India, America, the West Coast of Africa, and the shores of the Mediterranean, are, however, found in all extensive collections, so that it cannot be considered as a product peculiar to China. In Malta it is, I am informed, especially abundant, more so than the ordinary white kind. Whether it is produced by a peculiar variety (not to say species) of the cotton plant, or whether the colour is owing to peculiarities of climate, soil, or method of culture influencing the plant, is, on the other hand, a question not easily determined. Considerable doubt indeed prevails as to the number of species embraced by the genus *Gossypium*, and the characters by which they are distinguished from one another, some authorities admitting only four species, whilst others describe more than twenty. Among the former is Dr. Forbes Royle, who says:* "The result of our investigation of the species of the genus *Gossypium* is, that there are at least four distinct species which may be easily distinguished, and that the great mass, probably the whole of the cotton of commerce, is yielded by three of these species and their varieties." Attempts have been made to distinguish the various species of *Gossypium* according to the colour of the cotton produced by them, but, as might be anticipated, with little success, since the colour of the organs of plants seems to be one of the least persistent of their characteristics. Anyone, indeed, examining a collection of specimens of cotton fibre must see that there are few marked distinctions between them as regards colour, none being absolutely white, and the greater number exhibiting various shades of cream colour, verging to fawn. Nankin cotton may be considered as being placed, as far as colour is concerned, at the extreme end of the scale, at the other end of which we find Sea Island and other almost pure white kinds. Several authorities assert, it is true, that Nankin cotton is produced by one species of the genus only, viz., *G. religiosum*, but others say it is found on more than one species. Among the latter I may again quote Dr. Forbes Royle, who says: "*G. religiosum* of Linnæus seems to be distinguished from other species only by having tawny-coloured cotton; but we have seen that both the common Indian cotton, the Chinese cotton, the arboreous species, and *G. barbadense* all occasionally produce nankeen-coloured cotton, and that, therefore, it cannot be considered as characteristic." Referring to "China cotton" the same author says†: "The specimen in *Herb. Hook.*, from Mr. Fortune, is less hairy than most Indian specimens, though clothed with a number of short hairs. Mr. Fortune states, in a note with some specimens that he sent to Dr. Lindley, from China, that the white-coloured and the nankeen-coloured cotton are yielded by the same species and even by the same plant, and that the two kinds are separated by the Chinese. Besides India and China, this species is cultivated in Persia, Syria, Asia Minor, and the Islands of the Mediterranean, as well as in the north of Africa, and the south of Europe. The kind yielding the nankeen-coloured cotton in Malta is probably a variety." Fortune in his Travels,‡ makes the following statement regarding the cotton plant of China: "The Chinese or Nanking cotton plant is the *Gossypium herbaceum* of botanists, and the '*Mie wha*' of the northern Chinese. It is a branching annual, growing from one to three or four feet in height, according to the richness of the soil, and flowering from August to October. . . . . The yellow cotton, from which the beautiful Nanking cloth is manufactured, is called '*Tze mie wha*' by the Chinese, and differs but slightly in its structure and general appearance from the kind just noticed. I have often compared them in the cotton fields where they were growing, and although the yellow variety has a more stunted habit than the other, it has no characters which constitute a distinct species. It is merely an accidental variety, and although its seeds may generally produce the same kind, they doubtless frequently yield the white variety, and *vice versa*. Hence specimens of the yellow cotton are frequently found growing amongst the white in the immediate vicinity of Shanghai; and again a few miles northward, in the fields near the city of *Poushan*, on the banks of the Yang-tse-Kiang, where the yellow cotton abounds, I have often gathered specimens of the white variety." The opinion here expressed is confirmed by Parlatore, who affirms,‖ without hesitation, that the plant bearing red or reddish cotton is merely a variety either of *G. arboreum* or *G. hirsutum*.

Mr. Thomas Clegg, of this city, who is familiar with the properties of the various kinds of cotton, and well acquainted with their commercial value and places of growth, has kindly lent me some of his specimens for exhibition on this occasion, and in a communication received from him he has given me some information regarding Nankin cotton, which will, no doubt, be of interest to the meeting.

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* "On the Culture and Commerce of Cotton, &c.," p. 151.

† *Ibid.*, p. 113.

‡ "Two Visits to the Tea Countries of China," vol. i., p. 109.

‖ "Le Specie dei Cotoni." Firenze, 1866.

Mr. Clegg says: "I found Nankin cotton abundantly at Malta, many parts of Tunis, and in great quantities on the West Coast of Africa. Dr. Livingstone has sent me many samples of it, and I have frequently had specimens of it from other, but always arid, dry, and hot parts of the world. The Maltese has, however, always been the best. It is very short in staple, coarse, and of little value in itself, especially as so little of it is produced. Being high-coloured, of course if used alone it would give a high peculiar colour to the cloth, and as mixing it with whiter cotton generally stripes and spoils the cloth, it is in very bad repute. In China and Japan it gets more dusky and dark, and even lower in staple. On the West Coast of Africa it seems to be hybridised and modified in colour. The seed, when cleaned from the cotton, is generally only half-clothed with the fibre, the other half being black. But whether entirely Nankin-coloured or a little whiter, it is always on that coast much longer in staple, and, though rather coarse, still a good useful cotton. Indeed, the generality of the West Coast cotton is a nice cream-coloured cotton, a little higher than the old Demerara cotton used to be, and of staple on an average fully equal to American bowed upland, or the lower class of New Orleans, and I hardly think can be classed as Nankin at all, though high-coloured. If it could be had in quantity, it would, in my opinion, soon supersede all the lower qualities of American cotton. Nankin cotton is always, so far as I have seen, from fibrous-coated seed. As to colour, I cannot tell, being no chemist, whether it is fast or not, but it never seems to fade with me. . . . . According to my experience, it is only in very hot countries, and on a rather arid soil, that the really dark Nankin is produced. I think if experiments were tried for three or four years together, Maltese on the West Coast of Africa would resemble African, and West African seed sown at Malta would become Maltese cotton; and I almost think that West African seed which at home produces yellow-tinged cotton, would, in one or two years, in the New Orleans district, produce white cotton. And I further think that pure New Orleans seed sown at Malta in three or four years would give cotton of the red tinge of ordinary Maltese." Mr. Clegg seems therefore to agree with those who think that the variations in colour observed in cotton are entirely owing to differences of climate and soil, and are not peculiarities attaching to different species of the plant.

These remarks will suffice to give a general idea of the properties of Nankin cotton and its supposed origin. I propose in this communication to give a short account of some experiments made to ascertain the cause of the peculiar colour by which it is characterised.

The colour of Nankin cloth having been successfully imitated in this country by depositing oxide of iron on and within the fibres in the manner well known to dyers, it might be supposed that the colour of the raw cotton was due to iron in some form. The simplest experiments prove this, however, not to be the case. The cotton on being incinerated leaves an ash which does not contain a larger proportion of iron than that of ordinary cotton, and the colour is not removed by treating the cotton with dilute mineral acids capable of dissolving oxide of iron, whereas the colouring matter dissolves, though slowly, on boiling it with caustic soda lye. Another mode of imitating the colour consists in mordanting the fabric with alum, and then dyeing with oak bark, the process resembling that by which calico is ordinarily dyed of a yellow or fawn colour. It is evident, however, from its resisting the action of acids, that the colour of Nankin cotton cannot be due to the presence of a lake of alumina or any other base. In order to arrive at some conclusion regarding the nature of the colouring matter, it was necessary to employ large quantities of material, for though the colour looks intense when the cotton is viewed in mass, it is in reality produced by a small quantity of substance spread over a large extent of surface, in this respect resembling the colour of the petals of some flowers. I therefore had recourse to the plan adopted on a previous occasion, and described in a paper I had the honour of reading before this Society several years ago.* A quantity of yarn made entirely from Nankin cotton (from the coast of Coromandel) was submitted to the usual process of bleaching, and the dark brown liquid obtained by treating the yarn with boiling alkaline lye was mixed with an excess of acid, which produced a dark brown flocculent precipitate. This was filtered off, washed with water, and then treated exactly in the manner described in the paper just referred to. It was found to contain the same substances as the precipitate obtained in the same way from alkaline lyes with which ordinary Indian or American cotton had been treated, viz., cotton wax, fusing at the same temperature, and having the same general properties as that from ordinary cotton, a white crystalline fatty acid (probably margaric acid) pectic acid, parapectic acid, and, lastly, colouring matters. It is to the latter that the cotton owes its colour, for this colour is removed to a great extent by treatment with alkali, while the colouring matters are thrown down from the liquid on the addition of acid, and I therefore examined them with more care than the other constituents of the precipitate. These colouring matters I found to be at least two in number. One of them is easily soluble in alcohol, and is obtained, on evaporating the solution, as a dark brown, shining, transparent resin. The other is almost insoluble in cold alcohol, but dissolves in boiling alcohol, and is deposited, on the solution cooling, in the form of a light brown powder. Their properties are in general the same as those of the analogous colouring matters from ordinary cotton. They contain, like these, C, H, N, and O, but in somewhat different relative proportions. Their composition in 100 parts I found to be as follows:—

	A. Colouring matter soluble in cold alcohol.	B. Colouring matter insoluble in cold alcohol.
C	58·22 ..	.. 57·70
H	5·42 ..	.. 5·60
N	3·73 ..	.. 4·99
O	32·63 ..	.. 31·71

The composition of the analogous colouring matters from American cotton, according to previous determinations, was as follows:—

	A.	B.
C	58·42 ..	.. 58·36
H	5·85 ..	.. 5·71
N	5·26 ..	.. 7·60
O	30·47 ..	.. 28·33

The difference in composition, in the first case at least, is not greater than may be expected with substances of the purity of which, in consequence of their not occurring in a crystallised state, one can never be perfectly sure. On the whole, I think these experiments justify the conclusion at which I have arrived, viz., that the colour of Nankin cotton is due to the presence of bodies which are very similar to, if not identical with, those which cause the much fainter tints of the ordinary kinds. They show, too, that the substances accompanying the cellulose (whether clothing the fibres, or contained in their inter[illegible] are the same with this variety of cotton as with al[illegible] thus [illegible] at state previously examined.

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* "Memoirs," [illegible]

"*An Improved Method for preparing Marsh-Gas,*" by C. Schorlemmer, F.R.S.

Everyone who ever had to prepare soda-lime knows that the preparation of this substance is a troublesome as well as a laborious process. Chemists will therefore hail with pleasure a paper "On the Determination of Nitrogen," by S. W. Johnson (*Liebig's Ann.*, 169, 69). He has found that in using the method of Varrentrapp and Will, soda-lime may be replaced by an intimate mixture, of about equal weights, of anhydrous sodium carbonate and dry slaked lime. It occurred to me that such a mixture might also be employed instead of soda-lime in the preparation of marsh-gas, and I found that by heating an intimate mixture of anhydrous sodium acetate with more than twice its weight of lime and sodium carbonate, a very regular and quiet evolution of marsh-gas took place. The gas thus obtained always contains some acetone, which is easily removed by shaking it with water, or, better still, with a solution of acid sodium sulphite.

GLASGOW PHILOSOPHICAL SOCIETY.
(Chemical Section).

Ordinary Meeting, December 8th, 1873.

Mr. Edward C. C. Stanford, F.C.S., President, in the Chair.

In his inaugural address as President of the Chemical Section, Mr. Stanford said it was not his intention to review the progress of chemical science in this country during the past year; indeed, he was more disposed to call attention to what we ought to have done than to congratulate ourselves on what we have done. No one who studied that extremely valuable synopsis of original papers now published by the Chemical Society could fail to remark what a small proportion of that volume was devoted to the discoveries of British chemists. There was no doubt that original researches were becoming scarcer in this country. There were several reasons for this diminution. In the first place, we had lost a number of eminent men, who might be considered irreplaceable in this respect—Faraday, Miller, and a Glasgow citizen, Graham, were no longer with us. One of the most accomplished living chemists had entered our Government, and although the tardy recognition of the value of scientific knowledge at head-quarters had been appreciated, and although we might applaud the elevation of a man who would do honour to those who had elected him as a colleague, we nevertheless mourned the chemist lost.

We could scarcely speak of the eminent men we had lost without mentioning Liebig, whose name had been so long even a British "household word." For fifty years his prolific inventions had filled our scientific journals with original papers, involving most important discoveries. Although chemical books were not generally very readable works, he had the charm of writing his views so as to give the world instruction in the most attractive form, and perhaps no man had done so much to make chemical science popular. He (Mr. Stanford) hoped that Liebig's example would not be forgotten, and that his industry might stimulate all our young chemists. There was ample field for all; in fact, it might be said that the harvest was plenteous, but the labourers few. Chemical professors were now so engaged in the instruction of youth, in the detection of adulterations, and general analysis, that they have less time for original research. On each of these points Mr. Stanford proceeded to make a few remarks.

It had at last been admitted that the three R's did not *entirely* qualify a boy for society, and that even Latin and Greek, however well caned or birched into him, were not a *perfect* mental training. We had awakened at last to the belief that he ought to know *something* about the air he breathes, the food he eats, and the fluids he drinks. Some sanguine individuals had thought that even the earth he lives on should not be in every sense beneath his notice. Physical science as a mental training must sooner or later be recognised. Even with very young boys there could be no more valuable study than qualitative analysis; he knew of nothing which so easily brought out the powers of observation and reasoning, and these powers would retain their influence on the mind long after the problems of Euclid had faded from the memory; Humboldt says: "To behold is not necessarily to observe, and the power of comparing and combining is only to be obtained by education. It is much to be regretted that habits of exact observation are not cultivated in our schools: to this deficiency may be traced much of the fallacious reasoning, the false philosophy, which prevails."

The late Dr. Guthrie, in his "Autobiography," did not lament the accident which made him substitute the study of physical science for that of mathematics. Faraday's discoveries showed that the former was much more useful practically than the latter, aud the minds of these two men in their breadth, and their depth, and their fulness, showed the value of science teaching. We might look confidently for a large spread of this teaching in the present century.

The Adulteration Act would, when it was properly amended, and made universally compulsory, give increased employment to a large number of chemists, and even now the appointment of Medical Officers of Health in many places showed that the right men could not be got in sufficient number, or that the qualifications for the office were entirely misunderstood. Of all analysis there was nothing so difficult as the detection of adulterations; it required the very highest qualifications—not only the most consummate facility in ordinary analysis, but a large experience of trade, and a perfect knowledge of Materia Medica, and of the sources or manufacture of all our necessities.

Unfortunately, it had hitherto been mostly in the hands of microscopists; but now, when we were to punish the delinquents, we must have exact chemical quantitative evidence. In many cases the methods to attain this had yet to be discovered.

Then came the question of "What is adulteration?" and this, apparently, was not easily answered. Take, for instance, that ridiculous prosecution in London, where a druggist was fined for selling a well-known effervescent saline under the name of "Citrate of Magnesia," when it contained none of that body, and was known not to contain it; how that could be an adulteration he could not imagine. The Pharmaceutical Society were taking action in this instance, and it was to be hoped that the Pharmacy Act would prevent the analysts having to wander over the whole range of Materia Medica, for which they would probably be extremely thankful. A vendor was recently charged, in Edinburgh, under this Act, with adulterating beer with acetic acid, by selling a beverage known as "Hard Ale." Could any misnomer be more absurd than to call this an adulteration? In many parts of England where ale was the general beverage, and where much was "home brewed," there was a decided preference for "Old Ale," or ale which had to a certain extent undergone acetic fermentation. The old "strong beer" of the South of England harvest suppers, the best the master could give, was quite tart from keeping. As well might a wine merchant be fined for selling "Old Port," as a publican for selling "Old Ale." Mr. Stanford mentioned these two instances only to show how easily ignorance might abuse power; and if it were true that "power showed the man," then he said that the prosecutors in these cases were incompetent. So many other cases of gross miscarriage of justice under the Act were now so notorious that some amendments must ere long be made.

The amount of general analysis required throughout the country was very considerable; chemical manufacturers had ceased to be "rule-of-thumb" men; they bought and sold by analysis, and a most important element in every large chemical works was the staff of chemists and the laboratory. Even farmers must now have their manures bought by analysis; they had actually found out the value of analytical fees. This field for work must yet largely increase. With the late president, Dr. Wallace, he quite agreed, that these commercial analyses had attained a remarkable degree of scientific precision; indeed, he would go further, and, speaking from experience, assert that, thanks to him and the other analytical chemists in Glasgow, he knew of no large manufacturing centre where greater accuracy could be relied on. But they still required some more perfect universal standards of accuracy, and they ought to attain to some general methods which should make the differences among chemists impossible, or at any rate reduce it to a minimum. Unfortunately, manufacturers knew that there still existed the scandal to the profession of "high and low chemists," and that it paid best to sell by one and buy by the other. It was painful to reflect that scarcely two analysts would agree on the strength of a superphosphate, and still more painful, in an accurate science like chemistry, to notice how large the difference might be, even amongst the most eminent men. Again, look at the great difference of opinion as to the estimation of what was called previous sewage contamination in water, a subject the growing importance of which demanded from all chemists the most perfect concord. Again, take the statement of analyses, for instance, the arrangement of the acids in tabulating an analysis of a potash salt containing soda; chemists differed widely as to that, and it leads to great confusion. Then, in stating superphosphate analyses, was precipitated or reduced phosphate to be valued? and if so, as he believed it certainly ought to be, what was to be the solvent employed? Numerous other instances would occur to the members of the necessity of real standards; and he pressed the importance of the question on the meeting; indeed, he hoped to bring it before them again, because he hoped it would lead to some action being taken on the subject. The Chemical Society would not enter into such investigations, but it might be possible to obtain a committee appointed by the British Association, to inquire into the most pressing of these questions. There was now a precedent for this; for at the Brighton Meeting last year Mr. W. Chandler Roberts, Chemist to the Mint, through the Committee of the Chemical Section, got a committee appointed to inquire into the best method of making gold assays; this committee was still engaged in the work, but the first report was published. Now, there was nothing in analysis so accurate as gold assaying; these assays were correct to the 10,000th part of the alloy used, and yet, according to the Report, five independent assayers gave in assays of the same gold ingots, having the average difference of 6-10,000th parts. As the quantity coined last year was £15,200,000, an error of only 1-10,1000th part would make a difference of £1500. If such accuracy as this required a committee of revision, surely they might ask for the same for the comparatively crude methods on which chemists bought and sold, and the differences in the analysis of which (often 2 or 3 per cent) involved the loss, or the wrongful gain, of large sums of money. He would not attempt to estimate the enormous snms thus annually in dispute from differences in analysis, but they would at once perceive that, considering the enormous value of our chemical manufactures, it must be very considerable, and, he would add, it ought to be remediable.

The endowment of scientific research, so eloquently referred to by Prof. Williamson, and the late president of this Section, must become the policy of an enlightened and educational government; but here again there was nothing that required such good teachers, however diligent might be the pupils. A full and thorough knowledge of all that was known was absolutely necessary as a firm basis on which to build any new investigations, and Gmelin's "Handbook" alone was an extensive work to master. Moreover, the highest talent was required in the teacher if he would so instruct the pupil as to prevent him wasting his time over new methods which could not reasonably offer any chance of success; and point out the avenues which he should follow to gain the end in view. A talented friend of Mr. Stanford's, now deceased, used to say, that no better investment of mercantile capital could be made than to buy up the services of an accomplished investig ator, as, for instance, Faraday (if such a noble mind could be bought), and sell his discoveries. That was putting the matter on a commercial footing, but it was exactly the policy that the Government ought to see. And little would be done until they could be made to believe that the encouragement of scientific research must be a really good investment for the country. Time and money were quite as much required as talent, and they should be freely offered to those who were willing to devote their lives to hewing out the precious truths of science. But this is a practical age; and if the Government could be convinced that, while they spent such enormous sums on the cinchonas in India, the discovery of artificial quinine at home was not impossible, it might give them an interest in chemical research which would astonish themselves and chemists also. The French Government apparently did not think this impossible, and who should say what might be the result of a long and systematic and united investigation of several accomplished chemists backed by ample means in this direction? Alizarin and indigo had yielded to our search after truth; and there was little doubt that the alkaloids were a question of time and labour. Again the utilisation of waste offered a large field for investigation of a most profitable character; many substances which demanded considerable expenditure to merely get rid of, had now become a source of considerable profit. There was much still to do in this direction, and it was one in which the investigator might feel that he was doing the greatest good to his country. Seeing the advances made of late years no one could say that the chemical manufacturers of this country were not fully alive to the importance of the subject. And although original research was not very active there was some satisfaction to know that the Patent Office was as busy as ever. It might be that that was the only place to look for reward, but it spoke well for the talent of chemical manufacturers, that of late years some of the best original researches had been made by them,—during all the cares and anxieties which were inseparable from the management of a safe chemical works.

In conclusion Mr. Stanford made the following remarks:—And now having had a good deal to do with the origin of this Section, I wish to remind you of the real objects we have always had in view. We are very glad to receive such valuable complete papers as have since our commencement been read here, but we wish particularly to encourage short communications of investigations in progress, we do not mind how unfinished. We would be pleased to have any notes of laboratory phenomena brought before us for discussion; any little variations which would be considered beneath the notice of all but true philosophers, who have been called the observers of minute differences; any improvement of any process, however slight. In fact, if only some of you would give us short papers descriptive simply of failures, I do not hesitate to say it would be immensely instructive. Any investigator who knows a great number of methods that would answer is close on the track of one that will. What we want particularly here is food for discussion, and I would impress on our younger members that they should unhesitatingly supply this, as occasions arise and opportunities permit. It is always an advantage to a young investigator to get the opinions of others who are qualified to give them during the progress of a research. That timely sympathy and encouragement, often so valuable, will, I can promise, be always met with here.

CORRESPONDENCE.

"MANUAL OF PUBLIC HEALTH."

To the Editor of the Chemical News.

Sir,—I shall esteem it a great favour if you will allow me to publish in your columns that my authorship is confined, in this book, to Part III.—page 303 to page 374 inclusive,—and that I am not responsible for any other portion of the book.—I am, &c.,

J. Alfred Wanklyn.

December 26, 1873.

A PROBLEM.

To the Editor of the Chemical News.

Sir,—The proposal of "Arsenious" as a "Christmas Puzzle for Chemists" has suggested the following problem for the exercise of ingenuity.

Given, a liquid (free from organic matter) containing all the common heavy metals, to separate them *one* at a time—not in groups. The metals present to be (Aq.), Hg, Pb, Bi, Cu, Cd, Sn, Sb, As, Fe, Al, Cr, Co, or Wi (not both), Zn and Mn.

I believe I have a solution of the problem, but am not sure that the process would "work." Of course a very perfect separation is not expected.—I am, &c.,

Analysis.

ANALYST WORK IN NOVA SCOTIA.

To the Editor of the Chemical News.

Sir,—I see by late English papers that a man has been fined £10 for selling as citrate of magnesia a substance containing not a single grain of magnesia. This reminded me that about two years ago I examined some "citrate of magnesia" bought here, but whether imported from the States or the old country I do not know, and found it to consist of *sodium carbonate* and *tartaric acid;* the same results were got by some students in my laboratory the other day, on a sample bought here a short time since; so I suspect there is very little citrate of magnesia offered to the public.

Another instance of the use of new nomenclature came before me recently. An excellent "potash," made in the States, is sold here in tins, under such names as "snowflake potash," and the like. I procured a 1 lb. tin for twenty-five cents, and proceeded to make potassium chloride for use of students in testing. To my surprise the tests could not be made to answer. Presently it occurred to me that possibly the "potash" was *soda*, and this proved to be the case. It is, as I said, excellent, some grey and pinkish, some beautifully white; what I have contains no alumina, or only such traces as do not affect its value as an ordinary reagent. It might be supposed that the fact of its not deliquescing would be sufficient to show that it is not potash, but I have real potash brought from home nearly twenty years ago which remains perfectly dry in appearance, though the bottle has often been opened. Our atmosphere being not nearly as damp as that of England during the greater part of the year, and when I have been using the alkali, is no doubt the cause of this phenomenon which has often struck me as a curious proof of the dissimilarity of climates. The "potash" is made I suppose from cryolite.

That public analysts might occasionally find something to do on this side is evident from another fact or two I may mention. A physician once put into my hands here a little stick of "lunar caustic" he had got from the States; it was nicely wrapped in white paper and looked all right, but it was only *nitre*. Another physician had a receipt handed him by his partner in their drug-store, who was puzzled at some of the ingredients—extractum Blodgetti and alanine were some of these. The doctor said he had never heard of such things; however, the *reverend* inventor of the "Medicine for Consumption," to be compounded according to the receipt, was ready to furnish them for some dollars on *written* application at his office in New York—he could, somehow, never be *seen* there. A packet was got, and given to me for analysis. It was found to contain little but corn-starch, with a small amount of cochineal and Rochelle salt. The price for about 2 ozs. was five dollars I was told. I found that "alanine" was an old name for meconine, which I do not think the reverend inventor had much of, unless he had communicated with Professor Anderson, of Glasgow.—I am, &c.

Henry How.

King's College, Windsor, N.S.,
Dec. 15, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 17, 1873.

Second Memoir on the Mode of Intervention of Water in Chemical Action, and on the Relations Existing between Electromotor Force and Affinity.—M. Becquerel.—The following conclusions are drawn:—1. The mixture of two neutral saline solutions, giving rise to a double decomposition with or without precipitate, produces an unbroken series of hydrates, acids, and alkalies, by the mediation of which double decompositions are effected, which do not disturb the equilibrium of the electric forces. 2. In the reaction of acid solutions with alkaline solutions, there are equally-produced hydrates, by the mediation of which the combination of acids and alkalies is effected, as may be recognised by the production of electromotor forces; but, in this case, there is an excess of electromotor force, arising from the direct reaction of the acid and the alkali. 3. The determination of the electromotor force serves not merely to compare the respective intensities of the affinities, but, further, to follow step by step their variations according as the solutions are more or less diluted with water. 4. In the mutual reaction of an acid and an alkaline solution, containing the same number of equivalents of water, the electromotor force is in an almost constant relation with that arising from a couple whose solutions contain an equivalent of water more than the foregoing. Thus, the ratio of the electromotor force of the couple $SO_3,4HO$ and $KO,4HO$ to that of the couple $SO_3,5HO$ is equal to that of the couple $SO_3,5HO$ and $KO,5HO$ to $SO_3,6HO$ and $KO,6HO$. The relation then diminishes very slowly. This law appears to be general. We may, then, by means of a very simple empirical formula, find the electromotor force of any couple of the series which stands in a fixed relation to the affinity producing such force.

Action of Pure Water upon Certain Metals.—M. Chevreul.—The author points out that Guyton de Morveau long ago observed the action of pure water upon lead and zinc. M. Chevreul, being engaged in examining, in 1841, certain procedures for purifying water on ship-board, discovered copper in distilled water, deriving from a condenser made of that metal. In 1837, he pointed out the necessity of keeping all alkaline reagents in bottles free from lead, and urged the importance of always making "blank" experiments in toxicological cases to obviate the possibility of errors due to impure reagents.

New Process of Brewing Beer Unalterable on Keeping.—L. Pasteur.—This process has been already noticed.

Action of the Waters of the Seine and the Ourcq upon Lead.—M. Fordos.

Rotatory Power of the Hyposulphites.—M. E. Bichat.

Rotatory Power of Mannite.—M. Vignon.—These three papers have been already noticed.

Reply to Remarks by M. Tarry on the Theory of Solar Spots.—M. Faye.—M. Tarry argues that in the solar cyclones the current is ascending, not descending, from the analogy of our terrestrial cyclones, in which there is an afflux of air at the lower part towards the centre (not an escape). M. Faye's position is that the solar cyclones are clearly shown to be descending, and that our cyclones are probably not different. The turning movements of the photosphere extend downwards conically and indefinitely into the gaseous mass. Our waterspouts are mainly similar; also our tornados and cyclones, but less so. On our globe, the influence of the ground limits the natural development of the turning movements: the cyclones, *e.g.*, are truncated cones. Meteorologists are divided as to the aspirant force of cyclones; but, taking into account the limiting influence of the ground, M. Faye shows (from a sketch) that the (air) supply, and consequent *vis viva* of a waterspout, should, on M. Tarry's theory, diminish as the extremity approaches the ground (or water), becoming *nil* on contact, all communication with the lower air being then broken. But it is precisely then its mechanical effects are most violent. Hence the cause is from above, not from below—these vertical movements are descending, not ascending. A second objection raised by M. Tarry is that in our cyclones, if they resemble the solar spots, as conceived by M. Faye, we should find the air escaping from the centre, instead of moving towards it. M. Faye urges the limiting influence of the ground above referred to. The phenomena of waterspouts are freely developed on a large vertical scale; those of cyclones are checked at their outset. The cyclones are like vast waterspouts reduced to their mouth. If we could transport ourselves to the upper currents where the waterspouts commence, and where the orifice of their funnel is formed, we should there find the convergent movement of which M. Tarry speaks, and which is observed in cyclones. But we see waterspouts from below, and in air often calm, and where the original cause escapes us. On the other hand, the great movements of the atmosphere which give rise to cyclones involve at once the upper and the lower layers: we are at the very orifice of a funnel which cannot prolong itself through the ground; we are in the convergent movement which produces the cyclone—at the upper rudiment, in fact, of a gigantic *trombe*. Thus the word *trombe* would be more suitable for the spots, where the dynamical phenomenon is always complete and simple, than the word *cyclone*, which denotes a phenomenon hindered in its development by the surface of our globe. M. Faye has retained *cyclone*, as expressing more nearly the scale of the solar phenomena. The obstacle of the ground, while not affecting narrow gyratory movements, greatly influences larger ones, which are reduced, not merely to a turning disc, but to a simple ring, grazing the ground, and turning about a centre calm and free from clouds. The ring gradually dilates, and its velocity of gyration diminishes, till it ultimately disappears. The *trombes*, on the other hand (like the sun-spots), have no central calm space; if they dilate, it is not indefinitely; they differ from cyclones by gradually contracting; their vertical development is atrophied; and they seem to return to the clouds. Similarly, the spots are reduced to a pore, then to an invisible spot, and doubtless, they diminish as rapidly in depth. Waterspouts, American tornados, Chinese typhoons, and the great cyclones of 200 leagues diameter, are, then, all the same phenomenon, modified variously by the obstacle of the ground, which cuts the first at the point of their cone, the tornados much higher, and cyclones near their mouth, so as to reduce them to a turning ring. As to the fact of showers of sand and insects, urged by M. Tarry, M. Faye says he does not pretend to determine, in all its details, the resistance-action of the ground, and he thinks the gyration of a vast ring is not incompatible with the raising of slightly inclined currents, which brush the ground and raise particles from it; but this does not warrant M. Tarry's inference. The author points out that that terrestrial meteorology may gain valuable information from study of analogous phenomena in the sun.

Death of M. Burdin.—M. Bertrand recalled the services rendered to science by this eminent engineer. It is to him we owe the first turbine.

Reply to Observations by M. Oudemans on the Influence of Atmospheric Refraction at the Instant of Contact in a Transit of Venus.—M. Dubois.—The author had, previously to M. Oudemans, shown that the refraction would not have a sensible influence.

Employment of the Prism in Verifying the Law of Double Refraction.—M. Stokes.—The author is led, by M. Abria's note, to call attention to a method he has described to the British Association and Royal Society, and which he thinks more easy, general, and exact than that of M. Abria.

On some Metallic Spectra.—M. Lecoq de Boisbaudran.—(1). *Lead.*—When the induction spark passes between two electrodes of lead, the spectrum consists merely of narrow lines; when the electrodes get covered with oxide of lead, there are the numerous characteristic bands, and some of the lines then disappear, while others retain their brightness. The action of the condenser is almost exactly opposite to that of oxidation; it intensifies the lines, and, where they are extinguished through oxidation, the condenser restores them. (2). *Chloride of Gold.*—In a gas-flame, this gives magnificent bands crossed by slightly nebulous lines, extending from yellow to blue-green. With the spark in a solution of $AuCl_3$, the spectrum consists of green bands and a certain number of narrow lines, distributed between red and violet. The relative brightness of the lines varies according to the mode of operation. The author points out changes undergone by the lines *ε* 506·3 and *δ* 523 when one modifies the degree of dilution, the length of the spark, or the direction of the induced current. (3). *Thallium.*—The salts of thallium in a gas-flame give, besides the bright green line *α* 534·9, another, faint and nebulous, having for wave-length 568·0. It seems to belong to thallium, for its relative intensity is maintained with various salts of thallium carefully purified. (4). *Lithium.*—From theoretical considerations, the author was led to expect the probable existence of a new line in the spectrum, having 413·0 for wave-length. He obtains merely a trace of this line on passing the induction spark in a solution of LiCl, but it can be easily had with the spark in Li_2OCO_2 at red heat. Two series of measurements gave 412·9 and 413 for the wave-length.

Maximum Density of Water; Mechanical Explanation of this Phenomenon.—M. de Mondesir.—The author supposes each molecule of water to consist of four elements or atoms, having the form of a sphere or ellipsoid of rotation with vertical axes. They are tangent to each other, and their centres are in the same horizontal plane. They turn about their axes, and it is this movement that represents the latent heat of water, and constitutes a dynamical work estimated, in heat-units, at about 80 calories per kilog. While the movements continue, the body remains liquid; it becomes solid when they cease. It is then that, according to the principle of transformation of work, the work due to the movement of rotation will be represented by the dynamical work due to the expansion of ice. He next explains how the movement of the four atoms may be stopped. He supposes the liquid divided into an infinite number of *molecular prisms*, formed by four planes tangent to the molecule. The four atoms, to turn harmoniously, must have only four points of contact with each other; with 5, rotation is impossible. The molecular orientation commences to change at 4°, so as to present five points of contact at zero [this is shown by figures]

Two diagonally opposite atoms approach each other, and the molecular prism comes to have a lozenge, instead of a square, for its base. It is then that ice is formed, in crystals with angles of 60° and 120° (which quite agrees with observation). Again, the volume of water must necessarily increase between 4° and zero. Water dilates, in general, under the influence of heat; and, so long as the temperature exceeds 4°, the molecular orientation remaining the same, the total or apparent volume will vary proportionally to the atomic volume. But the molecular orientation changing under 4°, the proportion ceases. M. de Mondesir then shows, by calculation and examination of his prisms, that, taking 0·00046 as the coefficient of expansion of water, the volumes of liquid water at zero and at 4° will be to each other as the numbers 1·00335 and 1.

Frigorific Effects Produced by Capillarity along with Evaporation.—(Continued).—M. Decharme.—When the jet of a pulveriser containing water is directed against a piece of porous paper dipping in sulphide of carbon, there is no formation of hoar-frost; but a jet of pulverised sulphide of carbon produces on the paper a circle of arborescences, increasing with the time. Directed to a thermometer-bulb, this jet will bring down the temperature from +10° to −22°. On a glass plate, the arborescences may be observed with a microscope. Among various porous substances submitted to the capillary action of sulphide of carbon, ordinary wood charcoal is of special interest; the sudden cooling produces contractions and crackings, often leading to rupture of the piece. The arrangement of the icy arborescences corresponds to the openings of the capillary vessels, terminal or lateral; they are in concentric crowns at the end, and arranged parallel on the lateral surface. The liquids capable of producing, like sulphide of carbon, arborescences in porous paper are (so far as known) chloroform, sulphuric ether, bromhydric ether; there are probably others among those whose boiling-point is under 60°. Sulphide of carbon gives the most rapid and intense effects, though its boiling-point (48°) is higher than that of sulphuric ether (35·5°), and the tension of its vapour (302 m.m. at 20°) is less than that of ether (433 m.m.). The frigorific effects on the thermometer-bulb wrapped in porous paper were nearly the same for all the liquids except chloroform, which diminishes the temperature less. The icy arborescences seem to be purely aqueous. Their point of fusion was exactly zero temperature, whatever liquid the phenomenon was got from; their taste and smell are *nil*. The water of fusion has the same density as that of pure water, and it gives the same velocity and capillary height in tubes and porous paper as water.

Quantity of Ammonia Contained in the Air at Different Altitudes.—M. Truchot.—The author finds that, while the proportion of CO_2 diminishes as you rise in the atmosphere—having been successively 0·632 m.g., 0·405 m.g., and 0·342 m.g. per litre at the three stations adopted, viz., Clermont Ferrand (395 m.), summit of Puy de Dôme (1446 m.), and summit of the Pic du Saucy (1884 m.),—the quantity of ammonia, on the contrary, increases—having been found at these stations, respectively, 1·12 m.g., 3·18 m.g., and 5·55 m.g. per cubic metre.

Remarks on MM. Pelouze and Audouin's Apparatus for Condensation of Liquefiable Matters in Gas.—M. Colladon.

Employment of Carrier Pigeons in Aërial Navigation.—M. de Fonvielle.—From Biot and Gay-Lussac's experiments it appeared that the pigeons did not return to their cot unless let off when the balloon was near the ground; otherwise, the rare air was insufficient for flight, and they fell with accelerated velocity. M. de Fonvielle attributes the failure of some recent American experiments to want of attention to this. But he thinks one might utilise pigeons at any height if they were perched on a parachute, to which they would probably adhere till it reached a layer of air dense enough to fly in. A pigeon once dispatched by Mr. Glaisher, at a height of 6437 metres, when the balloon was rapidly descending, perched on the balloon till it judged the air *voluble*, and then set off to its cot. The author states that the *National* newspaper has a pigeon service for its last despatches from Versailles; it costs 30 francs daily. There are ten pigeons, which may carry five despatches the double voyage; the time of a voyage is fifteen to twenty minutes, according to the state of the atmosphere and direction of wind.

Reply to M. Faye as to the Solar Spots.—M. Reye.—The author insists on large ascending whirlwinds that have been observed on our globe. He calculates that, in a cyclone which occurred in Cuba in 1844, and had a diameter of 1440 kilometres, the quantity of air raised must have been at least 420,000,000 cubic metres, or 49 kilogrms. per second. The enormous cylinder formed by the hurricane would be filled with fresh air in less than five hours and a half. Another phenomenon insisted on is the thick layer of dense clouds which always covers the cyclone and surrounding regions, giving torrents of rain.

Direction of Propagation of Electricity.—M. Neyreneuf.

Reply to M. Mercadier's Last Note on the Vibratory Movement of an Elastic Wire.—M. Valerius.—The writer compares the laws he had previously established with those given by M. Mercadier.

Mass of Meteoric Iron Discovered in Digging a Trench; Molecular Structure of Meteoric Iron; Solid Protochloride of Iron in Meteorites.—J. Lawrence Smith.—The mass was found by a farmer in the county of Howard, state of Indiana, and at 60 centims. depth. It is an irregular oblong oval, and weighs 4 kilogrms. When the surface is polished and treated with nitric acid, it gives none of Widmannstaetten's figures; indeed, the piece belongs to that class of iron which is rich in nickel (the percentage of which was 12·29).

MISCELLANEOUS.

Varley Testimonial.—At a preliminary meeting of the Committee, held the 20th of November, Sir William Fothergill Cooke in the chair, it was resolved to recommend that a Memoir of the late Cornelius Varley, illustrated with a photographic portrait, should be prepared and issued under the superintendence of the Committee, and that a copy be presented to his family, in token of the high estimation in which he was held; and, further, that some memorial be erected to his memory at the place of his interment. That the foregoing resolution be communicated to the absent Members of the Committee, and to his friends generally, asking them for their approval and co-operation on the Committee, and that subscriptions for the above object be invited.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus employed in the manufacture of salt. Thomas Bright Wilson, Manchester. March 11, 1873.—No. 875. In my improved arrangement the heat necessary for evaporating the brine-water is obtained from the combustion of fuel in a separate furnace and chamber, from which chamber the heated products of combustion are forced by a steam jet under one or more evaporating pans containing brine; the heat is imparted to the brine, and the cooled gases are allowed to escape into the air by a short pipe regulated by a valve or damper.

Improved combinations of substances or materials to be used as a substitute for coal, for obtaining heat and light, and in the arrangement of the furnaces or fire-places connected therewith. Joseph Jones, practical chemist, Great Lever, Lancaster. March 12, 1873.—No. 891. This invention consists, first, in combining, in various proportions, inferior coal, coal refuse, coal base, with sulphur stones, small pieces of paving or other stones, iron stones, copper stones or other pyrites, mud, peat, or earth, the constituents of water and water, and also the constituents of air and air; and, secondly, in improved arrangements of the furnaces to suit the requirements of combustion. In one proportion—

The coal base is	75	parts of a hundred.
Mud, earth, or peat	10	,, ,,
Broken stones	6	,, ,,
Pyrites	6	,, ,,
Simple water or its constituents, or the excess in peat or earth	3	,, ,,
	100	

These proportions are variable, but the main feature is to use the coal refuse and coal bases with one or more of these materials, so that when they are once ignited by wood or ordinary fuel the combustion of the gases give off intense heat and consume the several substances, the moist mud, earth, or peat, which are at present required to be dried. In order to adapt the furnaces or fire-places for the combustion of the before-mentioned substances, it is necessary that the admission of air or its constituents should be perfectly controlled or regulated, and therefore the door or front of the furnace or fire-place and ash-pit should be kept closed, there being only a certain number of holes for the entrance of the air or its constituents, and a damper in the flue or chimney to vary the draught of air, some of the holes being stopped up when required. The fire-bars should be loose, with their ends in front, and a lid provided to prevent unnecessary admission of air, and the ashes can be let down into the ash-pit by turning or agitating the ends of the fire-bars.

Improved means of and apparatus for filtering or separating water from earthy matters from which cements and similar bodies are made. Frederick Burnett Houghton, 40, Borough Road, Southwark, Surrey. March 12, 1873.—No. 902. This refers to several special forms of apparatus for facilitating the separation of water from cement and other similar slip or slurry, details of which are described in the Provisional Specification.

Improvements in apparatus for dealing with sewage and other refuse or waste, so as to lessen the pollution of rivers. Robert Stevenson Symington, telegraph engineer, Glasgow, Lanark, North Britain. March 13, 1873.—No. 912. This invention relates to improvements in apparatus for the better carrying out and extending of the system described or referred to in No. 2667 of 1868. In one modification a neat and sightly cast-iron structure is used, being of a rectangular form in plan, and also having a rectangular contour in elevation, but with an arched space beneath the middle part of it. This cast-iron structure is provided with two inlets at the top, one for the connection of a soil-pipe from a series of water-closets, and the other for the connection of a waste-pipe from a series of sinks or jawboxes, baths, wash-hand basins, or the like. There are a compartment for solid matters and two filtering compartments for the liquids, whilst beneath there are receptacles for ashes and for vegetable and animal refuse. Various modifications are indicated.

Improvements in apparatus for condensing the vapours of naphtha. Charles Moseley, india-rubber manufacturer, Ardwick, Manchester. March 13, 1873.—No. 916. This invention consists in certain improvements in or additions to the invention for which former Letters Patent were granted to me on the 30th day of May, 1872, No. 1637. My present invention consists in causing the vapour current, after leaving the condensor, to pass through a number of wire gauze partitions fixed at intervals in a tube or cistern, which is kept partially filled with liquid naphtha, so that contact is formed between the body of naphtha and the vapour.

NOTES AND QUERIES.

Iodate of Calcium.—Will any of your correspondents inform me me where the iodate of calcium, described in Chemical News, vol. xxviii., p. 297, can be obtained?—Chelt.

Fuller's Earth.—(Reply to A. K. C.)—In reply to a query in Chemical News, vol. xxviii., p. 316, you will oblige us by stating that fuller's earth may be obtained from us, who are the patentees of the use of it for refining oils, &c.—Lambe & Sterry.

Fluorescent Spectra.—(Reply to W. J. Grey.)—Many substances (as, for instance, sulphate of quinine, uranium glass, and some constituents of crude petroleum) have the power of reducing the wave-length of the ultra-violet rays so as to produce visible light; and the "fluorescent spectrum" is the spectrum of this light. See Roscoe, "Spectrum Analysis."—H. R. Procter.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

3314. (To Mr. Mechi). Have you perceived any effect upon the springs and brooks which has been caused by the escape of the liquid into them after passing through the earth?—Very frequently.

3315. (To Mr. Mechi.) Is the land of which you are speaking drained?—The land is all drained at various depths, and no matter what the depth is, whether it is five feet, three feet, or seven feet, (for I have drained at all those depths), almost invariably, when we irrigate, we find that a portion of the sewage comes through into the brooks.

3317. Is it a very good soil?—It is a very stiff tile earth; a very great deal of it is too strong to make bricks of.

3318. And do you still find that some of the sewage escapes?—I do, and that the water comes through frequently coloured by the sewage.

3428. (To the same.) Then the examination of Mr. Johnson continues—"All the really fruitful properties are taken up by the actual crop, and there is no additional value to the soil itself, unless you can be continually applying sewage to it; is that so? Exactly."—I think that that is not the case, for the reason which I have stated; and I know by Professor Voelcker's experiments that an important portion of the soluble and valuable parts of the manure filter through the soil and run away; I do not know whether the Committee have before them an analysis of that pure water that leaves Mr. Marriage's farm, because I am convinced in my own mind (and I should like to see an official testing of it) that, though that water is as pure in appearance as spring water, it contains a large amount of soluble, but invisible and valuable, material.

3468. (To Mr. Acland.) If the sewage, instead of being allowed to flow into the water and pollute it, was applied to the land, would it not be a great benefit, by reason of the greater supply of food that would be thereby produced?—Seven or eight years ago, when I wrote the essay to which your Lordship has referred, I suppose that was an universal opinion, but subsequent inquiries appear to have modified that; that is to say, that although generally speaking some portions of sewage are exceedingly valuable, yet, as will appear in many reports which I have, the opinion as to the high value of sewage, is exceedingly modified. That appears, for instance, in Professor Way's evidence in the first Report of the last Select Committee of the House of Commons of 1862, and also from Professor Voelcker's evidence; not that I would wish to give a chemical or an agricultural opinion upon that point. I merely speak from what I have read and what I have learnt. But I take it that the opinion as to the high value of sewage is considerably modified.

MEETINGS FOR THE WEEK.

Monday, Jan. 5.—Medical, 8.
Tuesday, 6.—Royal Institution, 3. Prof. Tyndall, D.C.L., LL.D., "On the Motion and Sensation of Sound."
— Zoological, 8.30.
— Anthropological 8.
Wednesday, 7.—Geological, 8.
Thursday, 8.—Microscopical, 8.
— Royal Institution, 3. Prof. Tyndall, D.C.L., LL.D., "On the Motion and Sensation of Sound."
— Royal, 8.30.
— Royal Society Club, 6.
Friday, 9.—Astronomical, 8.
— Quekett Club, 8.

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Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
(Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural)	11 a.m.	Classics (Junior)	9 a.m.
,, (Systematic)	3 p.m.	,, (Senior)	4 p.m.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 737.

THE POWER OF ATOMS.—SPECULATIVE.

Having begun to write on atoms, I am tempted to add a few speculations, which I trust will not be found too far removed from legitimate outlooks of reason, or too much in the region of fancy. Incapable as I am of seeing what we can do without Dalton's atom, it has been impossible to avoid thinking on the condition of things which existed before it. It has also seemed to me, as to many, that the primitive elements could not be many in number, from no inherent impossibility, but simply because of the tendency in Nature to proceed from the simple to the complex, and in doing so never to forget the past or to neglect the future. I have amused myself, therefore, by trying to make elements, as I have also amused myself by making forces to control them. I begin with one element, and I prefer the mode which I believe Graham first suggested of giving diversity. First let us read his own words from the *Proceedings of the Royal Society*, vol. xii., p. 620:—"It is conceivable that the various kinds of matter now recognised as different elementary substances may possess one and the same ultimate or atomic molecule existing in different conditions of movement. The essential unity of matter is in harmony with the equal action of gravity on all bodies. In the condition of gas, matter is deprived of numerous and varying properties with which it appears invested when in the form of liquid or solid. The gas exhibits only a few grand or simple features. These, again, may all be dependent on atomic or molecular mobility. Let us imagine one kind of substance only to exist—ponderable matter, and, further, that matter is divisible into ultimate atoms, uniform in size and weight. We shall have one substance and a common atom. With the atom at rest, the uniformity of matter would be perfect. But the atom possesses always more or less motion, due, it must be assumed, to a primordial impulse. This motion gives rise to volume. The more rapid the movement, the greater the space occupied by the atom, somewhat as the orb of a planet widens with the degree of projectile velocity. Matter is thus made to differ only in being lighter or denser matter. The specific motion of an atom being inalienable, light matter is no longer convertible into heavy matter. In short, matter of different density forms different substances, different inconvertible elements as they have been considered. What has already been said is not meant to apply to the gaseous volumes which we have occasion to measure and practically deal with, but to a lower order of molecules or atoms. The combining atoms hitherto spoken of are, therefore, not the molecules of which the movement is sensibly affected by heat, with gaseous expansion as the result. The gaseous molecule must itself be viewed as composed of a group or system of the preceding, inferior atoms following as a unit—laws similar to those which regulate its constituent atoms. We have, indeed, carried one step backward, and applied to the lower order of atoms ideas suggested by the gaseous molecule." He afterwards says, "the motion may be assumed to reside either in separate atoms and molecules, or in a fluid medium caused to undulate. A special rate of vibration or pulsation originally imparted to a portion of the fluid medium, enlivens that portion of matter with an individual existence, and constitutes it a distinct substance or element."

This ingenious theory of Graham does not teach us how to form atoms, but we may fairly look to some earlier state of matter—something utterly "without form"—for a beginning. At present, I begin with an atom ready formed, and start from the assumption that motion is the primitive, although not the only, cause of diversity in all the elementary bodies. We could imagine the different size or specific gravity to be decided by the different range of the motion, and other characters by the different quality of the motion. I should prefer the first, because we have then one matter and one motion, and the simplicity is at the utmost. Diversity I suppose to be obtained, first, by interruptions in the motion, and, secondly, by collocation of atoms. But I see no reason for limiting the range by anything like a vibratory movement; that is too complex. The motion may be at first free and uncontrolled, and the direction one and unchanging. We might suppose all the atoms moving in one direction, and we should then require some mode of bringing them together. For simplicity, I shall suppose that each moves in a direct line, but that the direction of each is not the same, leaving the cause of this. And now let us try, as many others have done before us, to begin a world out of these conditions.

It would be easy to say that these atoms would be attracted by each other, and so would soon rush together, but if we speak in that way we must put gravitation into the particles first, and that we have not done yet. Some one will say, Can you suppose matter to exist without gravitation? Yes, I can, and indeed my difficulty has always been to suppose it existing with gravitation, which is by no means an intellectual necessity, although a valuable property. We have only one exceedingly active atom to deal with; I say exceedingly, because it must have an irrepressible tendency (or desire) to act—one that cannot be destroyed, although its action may be controlled or put a stop to in some form. We can imagine a body like hydrogen, very active and little inclined to combine, being so broken in its spirits, to speak in metaphor, and compressed permanently, that it becomes, say, like oxygen, less disposed to move, but with more tendency to combine than before. It has given up one power for another. It has parted with activity and obtained strength and power to unite—power of attraction, power of affinity. We can still proceed, and, in our imagination, picture oxygen, or nitrogen, or any gas still more compressed—whether only mechanically or not need not now be asked,—so that it shall lose all power to move, and become a heavy metal—gold or platinum. To compensate for the mobility of its youth, it has now weight; it feels that it cannot go, but it has a longing to go: the tendency is irrepressible; it is the original force out of which all its properties grow. According to our ideas of the conservation of force, this is quite in order. The loss of an energy must show itself in some form, and I suppose the loss of the primitive stage of activity to be followed by the primitive stage of attraction, gravitation, exactly as the loss of the present stage of gaseous activity is followed by attraction, chemical.

With this in view, let these atoms interfere with the motion of each other, and something must arise out of this interruption. The first result may be heat, but heat is not a permanent stage of a body; it is the result of interrupted activity or of work done. The inalienable tendency—the eternal quality, if we may so call it—remains exactly as before, so far as strength is concerned; but, having no outlet as before, it can only *tend*; that is, it can vibrate probably, or in some way aspire—it can attract or repel. This first stage of activity being now interrupted permanently, an office must be had for the power which does not die, and this we find in gravitation. It is analogous to smaller acts that occur before us.

Gravitation now begins among these interrupted atoms, and it must be powerful and crushing. In the struggle of the chaotic crowd, the fates of particles would be various. Some would in the centre be obliged very early to give up the battle, and might soon lie down as gold or platinum, no longer caring for their neighbours, but as full of real life as ever, shown by their cosmic relations, their gravitating powers. We can have any amount of diversity in this respect up to hydrogen, which still retains much of its primitive activity, but little weight—some, perhaps, like the æther of space, traversing everywhere.

In this, we suppose that a certain degree of uncontrolled activity may exist without gravitation. What is the nature of the control? Is it merely mechanical pressure, or why does a substance come down from one high stage of activity to a low stage? How is the spring broken as one may say? We could imagine vibrations when motion is interrupted, and indeed we must; and we might even seek for stages, as in musical notes and the vibration of chords, but this mechanism does not so well suit our original supposition, although it is one that must some day be properly followed out. The original supposition would suit more a colligation of atoms; first two put together, then three, &c. This would make a complete series of bodies, and we should have the various forces of Nature given out according to the repression of these atomic activities. Doubling the atom might render the action slower, and thus we keep to Graham's diversity-of-speed theory pretty clearly.

(The power of making stages, instead of infinite gradations, is a great one, which we owe to Dalton. Whether it may ever be used to account for *species* is worth enquiring. At first one supposes that it is useless to look to atoms, because it would require so many to make the difference, for example, between a mammoth and an elephant. But germs are very small, and it may be that as a few atoms make a difference in organic molecules, so a few organic molecules, in a suitable position in a germ, may cause that to grow up a tiger which would otherwise have grown into a cat.)

But we must not be led too far from the object, which is to imagine a mode of obtaining gravitation, as well as diversity of atoms, with excessive motion. I need not attempt to proceed further, seeing that Grove's "Correlation of Forces" can be read. He begins with motion, and expounds with great beauty many laws, not including gravitation, however. I fear that my expositions cannot be so well proved, but it is sometimes pleasant to wander among the spheres, and to play with the mighty forces of Nature for a time. I do not remember that anyone has looked on attraction as a consequent of suspended motion, or attempted to look on gravitation as the result of diminished atomic action, producing in this way many so-called elements, but it is difficult to remember all one reads. I am also unable to recollect if anyone has separated sufficiently that activity, the suppression of which produces heat, from the eternal tendency to motion—the inherent life of the atom, and which may possibly exist as vibration within limited space in chemical compounds.

So far as I can see this matter, I say nothing opposed to any theory of heat and force now established, but, in traversing infinite space and time with abundant liberty, one is apt to take the wrong road; fortunately the way back is easy, since little depends on these visions. The illustration and prosecution of this idea may bring more solid truth, whilst attempting to prove the speculation that there is one original motion as well as one original matter.

Atom.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

In June, 1862, and in February, 1863, I had the honour to lay before the Royal Society communications on the subject of the then newly discovered metal, thallium. In these I gave an account of its occurrence, distribution, and the method of extraction from the ore, together with its physical characteristics and chemical properties; also I discussed the position of thallium among elementary bodies, and gave a series of analytical notes.

In the pages of the *Journal of the Chemical Society*, for April 1, 1864, I collated all the information then extant, both from my own researches and from those of others, introducing qualitative descriptions of an extended series of the salts of the metal. I propose in the present paper to lay before the Royal Society the details and results of experiments which have engrossed much of my spare time during the last eight years, and which consist of very laborious researches on the atomic weight of thallium. In these researches I owe much to the munificence of the Royal Society for having placed at my disposal a large sum from the Government Grant. Without this supplement to my own resources it would have been difficult for me to have carried out the investigation with such completeness.

Section I.—ON THE DETERMINATION OF ATOMIC WEIGHTS.

In determining accurately the atomic weight of a metal that stands so high in the scale as thallium, difficulties and sources of error which are comparatively small with elements of low atomic weight are magnified to serious proportions, and require more than ordinary care for their elimination. When so large a proportion of the compound under analysis or synthesis consists of the body itself whose atomic weight is the one unknown quantity, it is evident that the almost unavoidable errors occasioned by impurity in the materials employed, the losses incident to imperfect manipulation, or the inaccuracies arising during the weighing from the omission of the corrections required by temperature, pressure, &c., will all find their way into the number which is finally considered to represent the atomic weight of the metal.

Nearly fourteen years ago, on taking the chair of the Chemical Section of the British Association at Leeds, the late Sir John Herschel called attention to the necessity which there then was for the introduction of greater accuracy in the determination of atomic weights. Speaking of the numerical relations which appear to exist between certain groups of elements, he considered that all these speculations took for granted a principle with which chemists had allowed themselves to be far too easily satisfied, viz., that all the atomic numbers are multiples of that of hydrogen. "Not until these numbers," he continues, "are determined with a precision approaching that of the elements of the planetary orbits—a precision which can leave no possible question of a tenth or a hundredth of a per cent, and in the presence of which such errors as are at present regarded tolerable in the atomic numbers of even the best determined elements shall be considered utterly inadmissible—I think can this question be settled; and when such gigantic consequences —so entire a system of nature—are to be based on a principle, nothing short of such evidence ought, I think, to be held conclusive, however seductive the theory may appear. I do not think such precision unattainable; and I think I perceive a way in which it might be attained, but one that would involve an expenditure of time, labour, and money, such as no private individual could bestow on it." Before this remarkable sentence was written, Professor Stas had commenced his classical researches on the atomic weights; and in 1861 he gave to the world the results of ten years' experiments, which had been conducted with a care and perseverance never surpassed in the history of experimental investigation. These researches of Professor Stas, and others which he has since made public, constitute a standard of excellence which chemists who are engaged on the important task of the determination of atomic weights should strive to attain. They are, in my opinion, the most noteworthy chemical memoirs that have ever been written: not only have they determined in the most definite and unassailable manner atomic weights about which scarcely any two chemists have agreed since the time of Berzelius, but they have raised the standard of accuracy in all chemical laboratories, and have set an example which, if followed, cannot fail to

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[*] A Paper read before the Royal Society June 20, 1872.

exert an important influence on the progress of chemical science.

It has been with these researches before me that I have endeavoured to determine in a manner which should approach them in accuracy the atomic weight of thallium.

In the determination of an atomic weight analysis is inferior to synthesis; and especially is this the case when the number sought is amongst the highest known. The method followed should be one in which as few chemical elements as possible are employed, so as to reduce to a minimum the errors arising from inaccuracy in the determination of their atomic weights,—which errors, whilst they might on the one hand balance each other, on the other might accumulate in the same direction, and become a total error of exceeding magnitude in the atomic weight of the metal under investigation. The method adopted should also be one in which there is the greatest possible difference of weight between the substance taken for the starting-point and the one ultimately obtained; for the greater the amount of this difference, other things being equal, the less likely are the unavoidable errors incidental to the method, and which may be looked upon as constant, to injuriously affect the atomic weight obtained. For these reasons processes in which a weighed quantity of the metal itself is taken and converted into one of its salts seemed likely to afford the best results; and this, accordingly, is the principal method which I have adopted.

Every substance employed in such a determination is liable to introduce errors proportionate to its own want of purity. The most extraordinary pains have therefore been taken to secure the absolute purity both of the thallium employed and of the agents used to act upon it. The glass and other apparatus have been specially constructed for these researches, and the balances and weights have been of an accuracy never before surpassed in any research. Whilst nearly every other branch of manipulative chemistry has advanced to an accuracy vieing with astronomical observation, the operation of weighing, as almost universally carried out, is attended with grave imperfections. For ordinary analytical work, and perhaps even for more refined and accurate researches, the errors attending the ordinary process of weighing are unimportant; but in determining an equivalent so high as that of thallium no precaution whatever, which can either reduce an error to a minimum or eliminate it altogether, should be neglected. I am anxious to avoid the imputation of over-refinement in this research; but considering the fallibility of human operations, and especially those of so complicated a nature as I am about to describe, I have considered it better to err on the side of too great than of too little precaution, both in the purification of the chemicals, the arrangement of the apparatus, the time devoted to each separate determination, the removal of the errors incidental to the weighings, and the subsequent calculations. These latter have been especially tedious, as the numbers have generally extended to too many places of figures to allow the use of logarithms; each calculation has, moreover, been duplicated by different persons.

I have attempted two entirely different methods of arriving at the atomic weight of thallium. Had the results of these determinations differed materially, I should have extended the research to other methods; but as they nearly agree, it appeared unnecessary to incur so great an additional expenditure of time and material with no reasonable prospect of getting any but confirmatory results.

The first method, and that which I shall describe, consists in taking a known quantity of metallic thallium, dissolving it in nitric acid, and weighing the nitrate of thallium produced.

The second method consists in dissolving known quantities of sulphate of thallium in water, and ascertaining how much nitrate of barium is necessary to precipitate the sulphuric acid as sulphate of barium.

In the prosecution of these two methods, the materials employed, the transferences from one vessel to another, and the weighings, are reduced to a minimum, while several precautions have been introduced into the operations of weighing which are not usually adopted. No correction has been neglected that is not many times less than the probable error of a single observation; and, as I have stated, especially has attention been paid to such corrections as always influence in one direction, as in that for weight of air displaced. Errors, sometimes in excess and sometimes in defect, tend to disappear from the mean of a great number of observations.

I have for the foregoing reasons thought it necessary to dwell thus far upon the care I have bestowed upon my work. In the succeeding section I shall describe accurately the apparatus employed, including the balance and weights, and the necessary arrangements for weighing *in vacuo*. In the third section I shall enumerate the chemicals and the methods of preparing them and pure thallium. The fourth section will be devoted to the process determining the atomic weight and the weights obtained. The concluding section will consist of a calculation and discussion of results.

Section II.—Apparatus employed.

The absolute weight of any substance may be found by calculation from its apparent weight in an atmosphere balancing 30 inches of mercury, and from its apparent weight under, say, 25 inches of mercury; but the errors of observation, more especially those relating to the maintaining of a partial vacuum, will largely affect the result. Weighings obtained in atmospheres balancing 30 inches of mercury and 5 inches of mercury respectively will give a more accurate result; but the best weighings whereby the absolute weight of a substance may be calculated are undoubtedly one in air at ordinary pressure and temperature, and one in a highly rarefied atmosphere,—it cannot be said *in vacuo*, owing to the difficulty of working under such a difference of pressure between the atmosphere of the balance and that surrounding it.

The Balances.

Two balances were used. That which I shall call the *air*-balance was made by Messrs. Keissler and Neu expressly for this work, and will clearly indicate a difference of 0·0001 of a grain when loaded with 1000 grains in each pan.* It is always kept in a dry room of tolerably uniform temperature, away from draught, artificial heat, or chemical vapours, and was (in the most accurate experiments) only used when no fire had been in the room for at least twelve hours.

The second balance, which I shall call the *vacuum*-balance, is almost a duplicate of the first, of 14-inch beam, with agate knife-edges and planes, made by Oertling. It is enclosed in a cast-iron case connected with an air-pump, and so arranged that I can readily weigh any substance in air of any desired density, the rarefaction being measured by a barometer-gauge. The accompanying diagram (Fig. 1) shows the method of the connections. The upper and lower portions of the iron case are connected by flanges and bolts; while, to ensure that the joint shall be air-tight, there is cemented to each flange a band of thick unvulcanised india-rubber, a lead wire being laid between the two pieces of india-rubber. By this means, and by causing the arm by which the riders are adjusted and the key liberating the pans and beam to work in a double-packed stuffing-box, a nearly perfect

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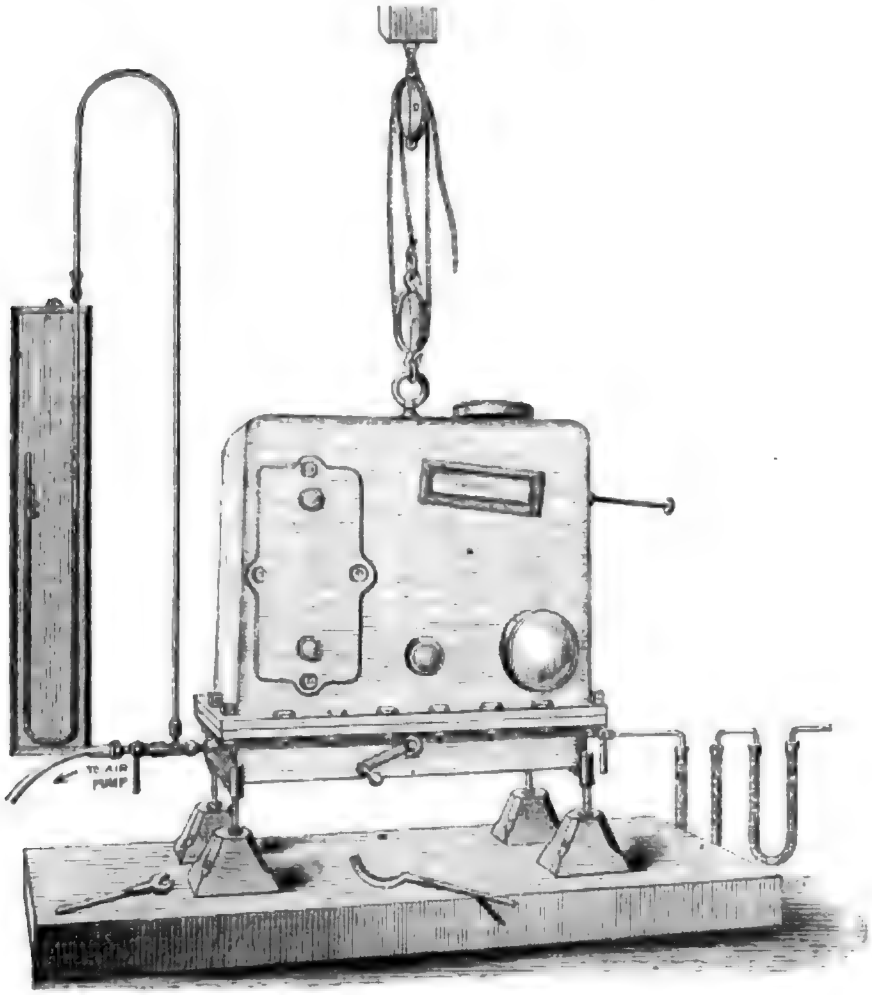
* M. Stas employed four balances. One of them when loaded with 1000 grammes turns with 5-10ths of a milligramme; another when loaded with 5000 or 6000 grammes turns with 1 milligramme, and with 2000 or 3000 grammes in each pan turns with 3-10ths or 4-10ths of a milligramme; the third balance loaded with 500 grammes turns with 2-10ths of a milligramme; the fourth laden 25 grammes turns to 1-33rd of a milligramme. Reducing these weights to grains, we find that—

No.	1	loaded with	15,432	grains turns with	0·0077	grain.
,,	2	,,	92,592	,,	0·0154	,,
,,	2	,,	46,296	,,	0·0060	,,
,,	3	,,	7,716	,,	0·0050	,,
,,	4	,,	386	,,	0·0005	,,

vacuum can be maintained. The openings in the metal work, through which observations are made, are fitted with clear stout plate glass; that to the left of the centre of the case, for the introduction of the apparatus, &c., is closed with an iron door, clamped and fitted with washers. The apparatus, when attached to the air-pump and exhausted to 25 inches of mercury, seldom allows the column of mercury to sink at a greater rate than 0·01 inch in an hour. A plug of gold-leaf is inserted in the tube, connecting the barometer-gauge with the vacuum-chamber, in order to absorb any mercury vapour that might otherwise be carried over.

Even with moderate rarefaction the iron case of the balance showed at first a certain amount of porosity, due to the "kish" or graphite, carbide, and silicide, diffused through the metal like a sponge. Cast-brass, and even drawn-brass, tubes exhibit a similar porosity. This porosity in the casing of the balance admits of easy remedy, by painting the whole surface with two or three thin coats of white-lead paint mixed with boiled linseed oil or fine copal-oil varnish, allowing each coat to dry before the next is laid on. The vessel should be painted when it is partially exhausted; the multitude of small holes then appearing in the smooth surface of the paint as it is forced inwards by the pressure of the outer air, should be covered carefully with thin coats of paint. When this effect ceases, a final thin coat should be given and allowed to dry.

Fig. 1.



The iron flanges were first planed true with the planing-machine, and then "fined off" by Whitworth's process of scraping, generally employed for such work as slides of engines, &c. The lead wire laid between the flanges of the iron case in india-rubber, becoming compressed when the bolts are tightened, effectually precludes the entrance of air. The washers of the iron door to the left of the case are of well-greased leather, while the glass plates in the other parts of the apparatus are cemented into double frames with red lead.

At first it was attempted to put nearly the correct weight into the pan, and then make the final adjustment by means of the rider. It was, however, soon found that the more accurate method was to introduce a certain weight, and then to alter the pressure of the air until the balance shows equilibrium. Thus, supposing a glass vessel weighing in air 625·1200 grains has to be weighed *in vacuo*, calculation estimates the probable weight (*in vacuo*) at 625·3700. I therefore introduce rather less (625·3600) than this weight, and exhaust until the balance attains equilibrium, when the gauge shows an atmospheric pressure equal, say, to 3·75 inches of mercury. When this is obtained the weight is slightly increased or diminished with the rider, and the exhaustion varied until a fresh equilibrium is established. Two weighings at different degrees of atmospheric pressure, varying by a considerable interval, give data upon which to calculate with great accuracy what the weight would be in a perfect vacuum.

With a rider there is some difficulty in estimating the exact point at which it rests, and it is necessary to note the oscillations, placing the rider as exactly as possible on one of the divisions of the beam. The best weighings, perhaps, will be taken when the arc is not very small.

Temperature has an effect upon the air-balance, rendering it less sensitive when increasing. This is perhaps due to the varying expansibility of the arms and the knife-edges upon which the pans are hung, or the superior and inferior parts of the beam may expand unequally. The two arms of the balance at times expand unequally; and in finding the true value of the weights employed in the determination, this cause of error is eliminated by following Gauss's method of interchanges—the constant friction of the forceps against the weights in transferring them from one pan to another being obviated by employing hooks of thin wire attached to the agate plane, upon which the suspension-wires of the pans could be hung. This required that the pans should not differ from each other by a quantity greater than one-thousandth of a grain.

In heavy weighings it is found convenient to remove one of the pans; but as the case is one of determining a weight and its increase after certain operations, the removal of the pan does not affect the result, provided the weight of the pan is accurately ascertained, and this weight allowed for, the apparatus weighed appearing lighter to an amount equal to this weight. Always when weighing different metals, or glass, or some chemical against metal, it is necessary to correct for the weight of air displaced, reference being at the same time made to the temperature and air-pressure; for assuming that there are to be weighed 7000 grains of bronze against 7000 grains of platinum, there will arise an error of nearly 0·6 of a grain unless this precaution be attended to, for 7000 grains of bronze displace roughly 1 grain of air, while 7000 grains of platinum displace only 0·4 grain.

At each weighing at diminished air-pressure care must be taken to allow the balance to remain at rest for at least half an hour, and preferably for several hours, in order to allow the temperature to become uniform after the alteration caused by the exhaustion. The weighings were always repeated a second time after everything had been allowed to remain at rest for one hour; and when the final weighing was made the case had been unopened for six hours, the adjustment being made by slightly altering the density of the enclosed air.

One of the greatest difficulties occurred in endeavouring to illuminate the scale and pointer of the balance without heating sufficiently to introduce a cause of error. The concentrated rays of a lamp were found to be unsuited in several ways. The use of a small vacuum-tube suspended inside the iron case was finally decided upon, sufficient light being obtained with two Grove's cells actuating a small induction-coil placed some distance from the apparatus, the electricity being conveyed by fine conducting-ing wires of good copper, carefully insulated.[*] These wires pass into the case through grooves filed in the flanges and well protected with india-rubber bands, and in no way interfere with the obtaining of a vacuum.

To prevent parallax the scale and pointer are viewed through a small telescope having a vertical wire in the focus of the eye-piece. The observer is therefore able to be situated some eight or ten feet from the balance during accurate observations, thus reducing to a minimum the disturbance due to the temperature of the body. It is inexpedient to estimate the value of a division on the ivory scale over which the pointer of the balance travels, as its value varies with the length of arc of vibration, with the weight in the pans, and slightly with the temperature. It is also evident that Gauss's method of weighing in alternate pans is inapplicable when weighing in a rare atmosphere, owing to the number of times the case would have to be opened, and the consequent liability to other sources of error. Borda's method, as described by Péclet in his "Cours de Physique," gives the most accurate results with the least expenditure of time. The weights are placed in the left-hand pan, and the object to be weighed in the right. At the last three consecutive oscillations of the pointer along the divided scale the division reached by the pointer is recorded, and

$$\frac{a + c + 2b}{4} =$$

the reading of the scale when the balance attains equilibrium. It is better to allow the first oscillation to occur unnoticed, and to record only the next three consecutive oscillations, while the first can be employed to check the result if required.

Finally, the balance-case contains a jar of pure oil of vitriol exposing a large surface, and another of caustic potash. The air is admitted through long U-shaped tubes, one filled with chloride of calcium, and the other with platinised asbestos.

For each weighing all necessary observations of the barometer and thermometer were made, as will be found noted in the fourth and fifth sections of this memoir.

(To be continued).

FLUORESCENT RELATIONS OF THE BASIC SALTS OF URANIC OXIDE.[*]

By HENRY MORTON, Ph.D.,
President of the Stevens Institute of Technology.

In the course of some experiments upon the effects of heat in modifying the fluorescent spectra of uranium salts, the following action was observed.

A little ammonio-uranic oxychloride, somewhat moist and having a little adherent hydrochloric acid, was heated in a test-tube in the flame of a spirit-lamp until it fused and gave off a little vapour. This treatment being repeated, a portion of the material became solid and opaque even while the rest was fused, and on cooling was found to fluoresce brightly with a continuous spectrum.

Some time after, on heating a neutral solution of uranic acetate to 100° C., a precipitate formed, which on draining and drying showed by fluorescence a continuous spectrum crossed by bright lines. By a slight washing a portion of this was obtained yielding a continuous spectrum only.

Again, while drying some sodio-uranic sulphate at 150° C. a portion placed suddenly in the oven in a moist state was found to yield a continuous spectrum by fluorescence like the others.

These experiments, however, yielded such small quantities and were so uncertain of repetition, that the obvious plan of analysing the bodies to determine their nature could not be well applied.

A little reflection suggested that the body present in all these cases might be a basic salt, as the uranic hydrates were excluded by the fact that they were without fluorescence.

I therefore attempted to make some basic sulphate, in the manner described by Prof. J. M. Ordway, *i.e.* by treating the normal sulphate in solution and cold with excess of barium carbonate. (*Am. Journal*, 1858, vol. xxvi., p. 208).

In the first attempt, however, to add an excess of barium carbonate to the uranic sulphate, all the uranium was precipitated. On the chance of repairing this misfortune some sulphuric acid was cautiously added, until a yellow colour appeared in the solution above the precipitate, and this solution was then concentrated on the water-bath.[†]

It refused to crystallise, but finally dried to an amorphous solid of a rich yellow colour, perfectly soluble and fluorescing with a continuous spectrum. On determining the sulphuric acid in this, it was found to correspond with what calculation called for in a salt having the formula $3(U_2O_3)SO_3 + Aq$.

Reflection upon this result suggested that the basic salts might be made not only by removing part of the acid from the normal ones, as in the method followed by Ordway, but also (as in the above case) by direct action of the acid upon the fresh and moist uranic hydrate, for it was evident that the substance here concerned was none other than this.

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[*] At high rarefactions this method of illumination fails, owing to the induced current passing between the wires outside the vacuum tube.

[*] Communicated by the Author.

[†] The barium carbonate here used was freshly prepared and moist. Some of the same quantity afterwards dried refused to react with the uranic sulphate.

To follow out this idea, I therefore prepared some hydrated uranates of potassium, sodium, and ammonium by adding the bases or their carbonates to solutions of uranic nitrate.

To different portions of each of these uranates, I then added sulphuric, nitric, hydrochloric, and acetic acids, in all cases stopping short of saturation, or after saturation adding more of the uranates until a portion remained undissolved.

In this way series of compounds were formed, all of which on evaporation to dryness yielded continuous spectra by fluorescence, though in some cases this was combined with a banded spectrum. The brightness of this action, however, varied greatly in the different salts in accordance with the variation in the second base as well as with the acid. Thus the salt formed by dissolving the ammonium uranate in hydrochloric acid had a very rich fluorescence (like that of the material first obtained by fusing the ammonio-uranic oxychloride), while the substance yielded by solution of the sodium uranate in the same acid showed a very faint fluorescence, resembling in this respect a specimen of basic uranic oxychloride prepared by Ordway's method. Remember that an ammonio-uranic oxychloride forms with great ease, while a corresponding sodium salt has resisted repeated attempts at its formation, we would be naturally led to conclude that we here had to do with a basic double salt in the case of the ammonium compound, and a simple oxychloride of uranium mixed with chloride of sodium in the case of the other.

When the solutions of various uranates in acids as above described are heated, they throw down copious precipitates, which also yield a continuous spectrum. These precipitates were drained on a filter without washing, as they are soluble in water.

A series of analyses was then made of the solutions as first prepared of the precipitates thrown down by heating to 100° C. and of the filtrate from this last.

Although the figures so obtained were in some cases to be considered only as approximations (the substances operated upon being more or less mixed), yet they pointed clearly to the following conclusions:—

1st. That the precipitates obtained by boiling the basic solutions were basic salts having such a formula as $3(U_2O_3),SO_3+RO,SO_3+Aq$.

Thus in the case of the ammonia salt we should have $3(U_2O_3),SO_3+NH_4O,SO_3+6HO$, or developing into a percentage form and comparing with the results of analysis—

	Calculated.	Found by Analysis.
$3(U_2O)_3$	= 73·0	74·0
$2SO_3$	= 13·5	12·3
NH_4O	= 4·4	4·8
$6HO$	= 9·1	8·5
	100·0	99·6

This shows us quite as satisfactory an agreement as we ought to expect when we remember that the substance was simply drained on the filter with the Bunsen pump without washing.

2nd. That the solution first formed corresponded very nearly with the above salt united with one molecule of the normal or neutral double sulphate.

3rd. That the filtrate from the precipitate consisted of the normal double salt holding a slight excess of base in solution.

4th. That the freshly prepared uranic hydrate or uranate is in a sufficiently active state to combine with acids in a higher proportion than that of the neutral salt, or, if not so combining, at all events to dissolve in the solution of the normal salt.

5th. That all the basic salts of uranium are distinguish by fluorescing with a continuous spectrum, and that we have in this a valuable means for discriminating between a basic salt and a precipitate of uranic hydrate.

Thus, it is generally stated, that, if the neutral solution of uranic acetate is heated, the precipitate thrown down is uranic hydrate. Such, however, as appears from the second experiment narrated at the outset, is not always the case, and in any instance the spectroscope will enable us to decide by a simple observation as to the nature of the substance in this respect.

Yet again, this enables us to confirm and localise an observation of Becquerel's, which might otherwise seem less satisfactory.

Thus, in the *Annales de Chim. et Phys.*, 1872, vol. xxvii., p. 546, he refers to a salt obtained as a precipitate on allowing a solution of impure uranic nitrate to cool. He names this "an ammoniacal subsulphate of uranium," and gives as the result of two analyses the following:—

$$\left.\begin{array}{lll} U_2O_3 & = & 4 \\ SO_3 & = & 2 \\ NH_3 & = & 1 \\ \text{Water} & = & 20\ \text{p. c.} \end{array}\right\} \text{or reducing this into percentages.} \left\{\begin{array}{l} 47{\cdot}6 \\ 23{\cdot}8 \\ 11{\cdot}9 \\ 16{\cdot}6 \end{array}\right.$$

This composition, allowing for its evident want of precision, is not unlike that of the solution first obtained by dissolving the uranate of ammonia in a minimum quantity of sulphuric acid.

The peculiar fluorescence noticed by Becquerel is then probably due to the presence of the basic salt—

$$3(U_2O_3),SO_3+NH_4O.SO_3+6HO$$

in the more or less mixed material which he examined.

He also states that he obtained accidentally analogous deposits in the preparation of some double sulphates, but he did not analyse them or follow up the subject further.

The subject of the actual condition of the solution first formed, and its relations to the neutral and basic salt, is now under investigation, and gives promise of interesting results.

All these solutions show banded spectra of fluorescence and absorption, which suggests the idea that they are rather mixtures than compounds, as has been before shown in the case of other double salts.

From the above observations generally, we see that basic salts of uranium are found under a great variety of conditions, some of which would be hardly regarded as favourable for such a development.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

The subject of this Lecture was "Latent Heat, and Heat in its relation to the Solid, Liquid, and Gaseous states of Matter."

The results obtained in determining specific heat by the method of mixture, and referred to water as a standard, taking equal weight, were first glanced at, and one especial point noted.† Taking into consideration what chemists call the combining weight of the elements, and considering all matter to be made up of atoms, let us conceive that these atoms have different weights, and that the combining weight of the elements are nothing more nor less than the weights of the atoms; then we find this remarkable circumstance that the product of the specific heat into the combining weight presents so great an equality for all the elements—whether solid, liquid, or gaseous—that it approaches to identity. As the result of that supposed identity, granting that the non-identity is due to imperfect experiments, or to the possibility of one and the same element occurring in different forms, as in C, P, and S, we are at liberty to assume the following as a most elementary fact, *that to heat an atom of any substance, the same number of degrees requires the same quantity of heat.* Thus you see that a substance like H, which has the lowest of all atomic weights, requires for a given weight the greatest quantity of heat to raise it through the same range of degrees. So, looking over the list, we find that those bodies with the highest atomic weight have the lowest specific heat, in such a manner that, when the two are multiplied together, the product is a constant. Hence, if we determine the atomic weight of an element, we determine thereby its specific heat, assuming this law to hold good.

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* Abstract of the fourth of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 8th ult.

† In the case of gases, however, two units of comparison are used, H and air. H is perhaps the most scientific, air the most useful for experimental purposes, because it is so universal in its distribution. The comparison between the results obtained by taking H and air is easy to perform, if one determines the specific heat of the gas H, and he mixture of gases, air.

Recurring to the illustration of filling a body with heat, to the filling of a vessel with water, imagine a cylinder of a certain capacity with two side cisterns of any capacity leading out from it, the one above the other; and if we pour water into such a compound vessel, the vessel will be filled till it gets up to the mouth of the first cistern, then all the water poured in will go to fill this, and until that is done no further rise in the level of the water will take place; and so on till the mouth of the second cistern is reached, and when that is filled, the rise will go on as before. The mouths of these two cisterns find their analogy in matter at the melting- and at the boiling-point. When heat is applied to a solid, it gets warmer until it begins to melt. As long as any of the solid remains unmelted, the heat which is continually being poured into it melts, but does not heat it. It does not become sensible heat, but it changes the state of the solid, and becomes latent heat, which is not apparent to the thermometer. Thus, if we take a mixture of ice and water, and warm (put heat into it), as long as there is ice present the temperature remains the same. Hence, the temperature of melting ice is taken as a fixed temperature, because we have a large margin or equality of temperature. The heat which goes into the ice without warming it is called "heat of liquefaction." Again, the liquid so obtained, or another on receiving heat, becomes warmer until the liquid boils. As long as any liquid remains, the heat which enters it does not become sensible, but changes the state of the liquid, and is sometimes said to be latent in the vapour. Such heat is heat of vaporisation. The heat of liquefaction is given out or withdrawn when the liquid freezes; the heat of vaporisation is given out when the vapour condenses.

Consider first the latent heat of steam, then of water. The latent heat of steam can be determined in the following simple way. Take, say, 100 grms. of ice-cold water and pass steam into it until the water is at 100° C. In doing so 10,000 heat-units will be employed (100 times 100) and the steam being at 100° as it passed out of the boiler will not have lost any temperature because it will be converted into water, but it will have lost a certain number of units of heat to raise the 100 grms. of water from zero to 100° C. Then find the increase in weight due to the condensation of the steam, that steam having the same temperature as boiling water, but having given up its latent heat, which has been sufficient to raise 100 grms. of ice-cold water to 100° C. This increase shows the quantity of steam that condensed and did this amount of work, heating this quantity of water to these degrees. Dividing the number of heat-units employed (10,000) by the quantity of condensed steam gives the number 536, being the grms. of water which can be raised 1° C. by the condensation unaccompanied by cooling of 1 grm. of steam.

In a similar way the latent heat of water is obtained. Take first 200 grms. of ice-cold water and pour upon it 200 grms. of boiling water; of course there will be 400 grms. of water and the temperature will be 50°. Next take 200 grms. of ice, not cooler or warmer than the ice-cold water, just melting in fact, and pour 200 grms. of boiling water upon it, then the temperature produced is not 50°, but something less, because a considerable number of the heat of the water will be used in melting the ice and not in warming it. In this way by pouring 200 grms. of boiling water upon 200 grms. of ice a temperature of, say 12° C. will be obtained when the ice is melted. Thus 200 grms. of boiling water in falling to 12° have given up 88 times 200, or 17,600 heat-units. These heat units have melted 200 grms. of ice, and raised the molten ice to 12°. In the latter operation 12 times 200, or 2400, heat units have been employed; there remains, therefore, 17,600 − 2400, or 15,200 heat-units which have been expended in merely melting 200 grms. of ice. Therefore, to melt 1 grm. of ice, 76 units of heat are necessary. Accurately measured the latent heat of water is 79·25. The latent heats of different vapours and liquids are determined by modifications of these experiments not convenient to enter into now.

Closely connected with the determination of the latent heat of bodies, *i.e.* of liquids and gases, is the relation between the three forms of matter—solid, liquid, and gaseous—and the heat which either determines the change from the one state to the other, or which accompanies the change. The relation between heat, and the solid, liquid, and gaseous states of matter may be expressed by the following scheme:—

Heat absorbed.
← ←
Solid. Liquid. Gas.
→ →
Heat liberated.

Which represents the following facts. (1) By giving heat to a solid you may fuse or melt it, thus converting it into a liquid—as when lead is put in the fire, it melts. (2) By giving heat to a liquid you may vaporise it, as by putting a kettle of water on the fire, the water evoporates. (3) By taking heat from a vapour or gas you may liquefy it, as a cold plate gets hot and wet when placed in the steam from the kettle. (4) By taking heat from a liquid you may solidify or freeze it, as water exposed to cold air freezes. Again, the above scheme expresses the four analogous facts. (5) When a solid liquefies, it absorbs heat, as when salt or saltpetre is put into water, the mixture is cold or in the act of absorbing heat. (6) When a liquid vaporises it absorbs heat, as water or ether on the hand makes it feel cold; it evaporates and absorbs heat. (7) When a vapour or gas condenses or liquefies, it evolves heat, as when a gas very soluble in water is passed into water, the water becomes hot. (8) When a liquid freezes or solidifies, it evolves heat, as a super-saturated solution of a salt on solidifying gives out heat. Various illustrative experiments were given here: one may suffice. A most striking example of the absorption of heat when a liquid passes into the gaseous state is presented by the liquid carbonic acid. The cold thus produced (the heat thus absorbed) by the vapour of the liquid is so great as to deprive the remainder of the liquid of so much heat that it become solid. A frozen residue can thus be obtained which is solid carbonic acid. By putting this in any gealable liquid such as ether, it will be cooled, not frozen, and any substance in contact with the pasty mass—mixture of ether and carbonic acid—is frozen. Hg was frozen by this means, and the frozen Hg, plunged into ice-cold water, froze the water, while the Hg itself melted.

By converting solids into liquids also, we get a considerable amount of cold, *i.e.*, they absorb a great quantity of heat. Supposing we take a mass of salt and bring it in contact with the ice; there is a tendency for the salt to dissolve in water, and water will be formed by dint of the tendency of the salt to dissolve in water, the ice will melt to dissolve in the salt, and the salt will melt in the dissolving ice; therefore, heat is absorbed. When you scatter salt upon ice or snow, it melts, though it is not warmed, but, on the contrary, cooler to the hand than the snow itself. You force these two solids to take the liquid form, and heat is absorbed from any substance in contact with these. That is the theory of freezing mixtures.

Again, all liquids endeavour to vaporise. When a liquor rises in vapour, it has to displace the air which presses on it. If the air be removed, the vapour rises more freely, and consequently the liquid and bodies touching it lose heat more quickly. Accordingly water can be frozen by quickly removing the vapour which arises from it, and this may be done by the air-pump, or by freezing the vapour. Take a sealed tube containing nothing but water, and the vapour of water, obtained by sealing, when boiling, and remove the vapour of water by cooling the tube. You can withdraw the heat from the vapour of water by a freezing mixture, and then as ice it will not occupy the same space as vapour of water, and no longer press with the same force. More vapour will rise from the water, but only to be condensed in the bulb by giving up its heat to the mixture of ice and salt. It will, therefore, continuously evaporate, and the result is it passes from the liquid to the gaseous state. That vapour of water as it rises carries the heat with it as vapour, to give it up to the freezing mixture, to melt that freezing mixture, and the water which gives up the heat ultimately freezes. This is the principle of the cryophorus or frost-bearer, but it might justly be called pyrophorus or heat-bearer, because really it is heat which travels.

When liquids are exposed to the air, three main forces act upon them. (1) The liquid strives to become a vapour, and to penetrate the air. (2) The pressure of the air restrains such a rise. (3) The force which assists the pressure of the air, or which acts against the diffusive tendency, viz., cohesion. If we diminish the latter force by so applying heat that the water swells, and its particles get further apart, we assist the evaporation. If we keep pouring heat into the liquid, so that the cohesion is kept continually below a certain amount, the liquid is rapidly converted into a vapour, the water boils. Or if we keep the temperature constant, and diminish the pressure, some liquids may be made to boil. At a given pressure different liquids boil at different temperatures, or have different "boiling-points."

The tendency which liquids have to pass into the vaporous state is called vapour tension, and it is measured by the effect which the liquids have in depressing the Hg in the barometer. Three liquids, viz., water, alcohol, and ether, are introduced into three similar tubes full of Hg to about 30 ins., and it is seen from the amount of depression that the vapour tension of ether at the same temperature is greater than that of alcohol, and that of alcohol greater than that of water and the tension of water greater than 0 (nothing) or ordinary barometer.

LIMITS OF ACCURACY ATTAINABLE IN ORDINARY WEIGHING.

By CHARLES W. FOLKARD.

It seems to me that the remarks made by Fresenius, in his "Manual of Quantitative Analysis" (sixth English edition), relative to weighing, are liable to mislead. In page 18 he says—"Where absolutely accurate results are required . . . the weight of the corresponding volume of air must be added respectively to that of the substance and of the weights, making thus the process equivalent to weighing *in vacuo*." Again, in page 17,—"A few minutes will generally suffice to ascertain the weight of a substance to within $\frac{1}{10}$ of a milligramme." He thus makes weighing to this degree a general rule, whereas the correction for this required only in absolutely accurate results.

Now it occurred to me that *bona fide* weighings to $\frac{1}{10}$th a milligramme would probably necessitate this correction, and I therefore made the following calculation, which seems to apply to many cases of quantitative analysis:—

A large platinum dish for water analysis weighs 75 grms.
The weights are of brass.
The specific gravity of platinum is 21·5.
" " brass is 7·0 (average).

Consequently the bulk of air displaced by the brass is three times that displaced by the platinum; but as this air is displaced when the dish is weighed with its water residue, as well as when empty, it is manifest that it would not affect the results provided its weight, and consequently its temperature and pressure, remained the same. Now the evaporation of a litre of water on the water-bath takes a day or a day and a half, and it will be granted that the pressure may fall ½ an inch in that period and the temperature rise say 11° C.

Now 1 c.c. of water weighs 1 grm.; therefore 1 c.c. of brass weighs 7 grms. (sp. gr. = 7·0); therefore the 75 grms. of brass have a bulk of 10·7 c.c.

So the bulk of air displaced by the weights is 10·7 c.c., one-third of this being compensated for by the volume displaced by the platinum; consequently the remaining two-thirds only are to be considered $10·7 \times \frac{2}{3} = 7·13$ c.c.

Now 1 litre of air weighs 1·293187 grms.; } at 0° C. &
consequently 7·13 c.c. weigh 0·00922 grm; } 760 m.m.

If the barometric pressure fall ½ inch = 12·5 m.m., this is $\frac{12·5}{760}$ of the whole pressure = $\frac{1}{61}$. Now the 7·13 c.c. of air weigh 0·00922 grm., and by this diminution of pressure will weigh $0·00922 \times \frac{1}{61} = 0·00015$ grm. less. Therefore the weights being buoyed up by 0·00015 grm. less, the dish will apparently weigh 1½-tenths of a milligramme more than before.

Also, if the temperature rise from 0° C. to 11° C. (which would often happen in winter), the 7·13 c.c. will expand $\frac{1}{25}$ of its bulk, and its weight will be decreased 26 : 25 = $\frac{1}{26}$ part.

Now $0·00922 \times \frac{1}{26} = 0·00035$ grm., and the dish will apparently weigh more by this amount.

So by these unprovided for circumstances the weighing varies two or three tenths of a milligramme; therefore, I ask, what is the use of getting within ½ a milligramme? It is needless to remark that no chemist would think it necessary to apply these corrections in ordinary analyses. The aqueous vapour, and consequently the amount of hygroscopic moisture, would probably also exert an appreciable influence.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 30th, 1873.

Dr. Lunge, President, in the Chair.

The Secretary read the Committee's report and Treasurer's statement:—

The President then delivered his address, in the course of which he made the following remarks:—

Gentlemen,—My first duty, on welcoming you at the commencement of a new session, is to thank you for again conferring upon me the distinguished honour of presiding over your meetings during the ensuing winter.

Some of you no doubt have, like myself, paid a visit to the great International Exhibition at Vienna, the largest the world has as yet seen; but as, most likely, the majority of our members have not done so, it may not be uninteresting to them if I make a few remarks upon chemistry as represented at the Vienna Exhibition. That remark which first obtrudes itself upon me, must needs be uppermost in the mind of every English visitor to that part of the Exhibition, viz., that this country, still undoubtedly the largest centre of manufacturing chemistry in the world, would seem to be on a level, or scarcely on a level, even with Italy or Holland, as represented at the Exhibition. Only one alkali works on the Tyne and two in Lancashire appear as exhibitors, and there are only half-a-dozen cases or so besides representing the chemical industry of this country. It is not my place here to discourse upon the reasons which may have influenced the bulk of British chemical manufacturers in holding aloof from the Vienna Exhibition, reasons which anyhow have not prevailed with the chemical manufacturers of any other country, nor, indeed, with most of the other branches of British industry; but the result is anyhow an impression in the mind of foreign critics that there is not very much progress to report in the British chemical industry, at any rate since 1867, the year of the Paris Exhibition. Such an impression, whether justified or not, is undoubtedly heightened by the great public spirit with which Germany and France have exhibited in this branch, not to speak of the really surprisingly varied and good chemical exhibition of Austria, since Austrian manufacturers might be expected to be on their mettle and do the best they could for an Exhibition in their own capital. Be that as it may, they have proved that even in that remote corner of Europe, with dear coals and comparatively very bad communications, a chemical industry has sprung up of the extent and variety of which perhaps few people in this country previously had a full idea. In stearin, paraffin oils, and soaps, Austria seems abreast with the best works abroad; a finer alkali works than that at Aussig, conducted by Dr. Schaffner, might be sought for in vain in this country; but even the more delicate chemicals are made largely in Austria, and of very good quality. Still, Austria is only in the second rank of chemical industry, even in the Exhibition, where the first rank can be only disputed between France and Germany, The exhibitions of both these countries are extremely fine and prove a most important advance since 1867. This particularly refers to the manufacture of coal-tar dyes, especially in the totally new branch of anthracen dyes. A good number of factories exhibit artificial alizarin, for which one single works in Germany is preparing plant for turning out the stupendous quantity of 100 tons per week. But also in many other branches, the most delicate chemicals which have only been produced in quantities of grains in the laboratory of some professor a few years ago, appear at the Exhibition in pounds, and at the factories in tons. It is somewhat humiliating to this country that the raw material for these beautiful preparations is, to a great extent, imported into Germany and France from England, and the manufactured articles are exported by them again to this country. The number of exhibitors and of articles exhibited in this special field alone is so large that I cannot attempt to go into any details, much as the subject would tempt me to do so, but I cannot refrain from contrasting the splendid array of glass cases filled with fine chemicals and dyes from France, and more particularly from Germany, with the comparatively small display which could have been made by England, even if it had seen fit to display at all. Unless this state of affairs is greatly altered, England will be left behind altogether in anything but what I might call the grosser kind of chemicals. The reason is not far to seek. You find in every chemical works on the Continent, I may say, without exception, one, sometimes several, chemists of thoroughly scientific training, who have acquired their theoretical basis by three or four years' studying at a University or a Polytechnical Institution. One works, to which I have already alluded, certainly one of the largest in Germany, keeps something like half-a-dozen such chemists (not practical managers), with salaries varying from £300 to £400, and it retains the services of an accomplished chemist, of scientific reputation, at a salary of nearly £2000 per annum, exclusively for theoretical work in the laboratory, without any trouble or responsibility connected with the manufacturing work outside. But then, they *do* constantly invent new things there, and make them in tons, or hundreds of tons, when the chemical world outside, has perhaps, barely heard of the discovery of a new compound, with a barbarous name, apparently only obtainable at the rate of a few grains in a sealed tube after many weeks' patient work. Of course, I do not mean to say that chemical industry, even of this finer kind, is not existing in this country; a mention of the firms of Perkin, of Roberts, Dale and Co., and many others, would be an instant refutation of such an absurd assertion; but what I maintain, after a visit to the Vienna Exhibition, and at a few German and Austrian chemical works, is, that foreign countries are taking the wind out of our sails very fast in this line, and that both their rate of progress and the means of attaining it are very much superior to ours.

For one country it is possible to give pretty reliable details, viz., for Germany, as considerable pains were taken by the German Commission to embody with their special catalogue a digest of all statistics they could accumulate. From the introduction to the chemical part of the German Exhibition, drawn up by the most competent hand of Dr. Hofmann, it appears that, to give just a few items, within the six years from 1867 to 1872 the German production of sulphuric acid has increased from 57,825 tons to 84,264 tons; sulphate of soda from 35.767 to 51,618 tons; soda-ash (calcined) from 26,250 to 36,227 tons; saltpetre from 3024 tons to 5311 tons; superphosphates from 1000 to 6850 tons per annum, as far as the returns go, which are very incomplete. A specifically German industry is that of Stassfurt potash salts, made from the "Abraumsalz" (waste salt) of the salt mines. It commenced in 1861 with 2360 tons; in 1863 already 64,400 tons; in 1867, 167,500; and in 1872 as much as 506,420 tons of this material were worked up in thirty-three factories. The articles manufactured from it amounted (in 1872) to 50,000 tons potassium chloride, (commonly called "muriate of potash"); 62,500 tons potash salts for manure; 2500 tons sulphate and carbonate of potash; sulphate of magnesia (both crystallised and anhydrous); 12,500 tons; magnesium chloride, 6500 tons; sulphate of soda (crystallised from the mother-liquor during the cold of winter), 7500 tons; boric acid, 20 tons; bromine, 35 tons. Another cluster of factories exists in Prussian Saxony for the manufacture of mineral oils and paraffin from brown coal (lignite), which turned out in 1871 5000 tons paraffin, 15,000 tons lamp oil, and 4500 tons heavy oils, and it is a good testimony for the technical progress made in this branch that the value of those articles only amounted to £600,000, whilst the prices of 1861 would have made it equal to £1,000,000, and yet the profit to the manufacturer was larger in 1871 than in 1861. To pick out a few other items: Germany produces 4000 tons white lead; 12,500 tons zinc white; 500 tons chrome green; 7500 tons ultramarine (worth £600,000), in which article it has almost the same pre-eminence as in most other colouring materials artifically produced. But most remarkable is this pre-eminence in coal-tar dyes. Of aniline colours Germany produces already now quite as much as all the remainder of Europe taken together (inclusive of England), amounting in 1872 to a value of a million and a-half sterling, and I can testify from personal knowledge that this production is expanding immensely at this moment, but it certainly is almost put in the shade by the gigantic development of the trade in artificial alizarin. This latter product, which was only discovered in 1868 by two purely theoretical chemists, Graebe and Liebermann, in that most theoretical way which used to be sneered at not many years ago by so many "practical" people in this country, has already led, in 1873, to a production of 1100 tons, value £600,000, but one single works in Germany (there are ten or twelve in Germany, and one each in England and France) is now preparing for a production of 5000 tons of alizarin paste per annum. Some of my hearers may possibly compare this with the turn-out of our alkali works, and think it not so very grand after all; but artificial alizarin is the outcome of intricate consecutive reactions in organic chemistry, and involves, quite apart from the highest chemical knowledge, a plant and capital at least equal to thirty, if not to fifty, times its weight of soda-ash. I just mention this to give an idea of the rate of progress in the manufacture of finer chemicals on the Continent. The same progress takes place in another industry which is altogether unknown in this country, viz., the manufacture of beet-root sugar; from 1400 tons in 1837 it had expanded to 263,000 tons in 1871 in Germany alone, accompanied by an increase of 150 per cent in the amount of sugar consumed per head between these dates.

I need not point out to you how interesting it would have been if other countries had followed the example of the German Commission in making their Exhibition Catalogue at the same time a most valuable exposé on the whole industry of the nation; but even in the absence of such accurate material for comparisons, it seems beyond any doubt that in one branch of chemical industry this country is still far ahead of all others, viz., in the manufacture of alkali, with all its introductory stages and subsequent ramifications, and this refers not only to the magnitude of the manufacturing operations, but also to the number of improvements and new inventions relating to this subject. Nrom this country have emanated condensing towers, lixiviating tanks, revolving soda furnaces, Weldon's manganese recovery, Deacon's chlorine process, to mention only a few things; but, apart from such single landmarks, I have no doubt that the whole style of alkali-making in this country, the shape of furnaces, the size of the batches, the details of working, are superior to those generally in use either in France or Germany. In the latter country I have found here and there complete imitations of the English method, as it is always distinctly called there, and it has answered so well that I consider it very likely it will be more generally adopted there. I may truly say that the English method seems to answer better in Germany than even in its own country, as far as the quality of the produce is concerned, and I can find no other explanation for this strange fact but the close supervision by trained chemists on the one hand, and the greater sobriety and docility of the men on the other hand. But it is again an English process which now causes the greatest stir among German alkali-makers, and which is believed by the International Jury at Vienna (whose president was Dr. A. W. Hofmann), perhaps too sanguinely, to be likely to supplant Leblanc's process in the immediate future. As this process is only being carried out by one works in England, which, I believe, is not even as yet in operation, it may perhaps not be out of place to conclude my remarks with a few words on it, although my hearers will probably take a less sanguine view of it than the Jury at Vienna. No doubt you will all guess that I am referring to the so-called ammonia process, which was first patented in this country in 1838 by Dyar and Hemming, but soon abandoned again. In 1854 it was vigorously taken up again by the celebrated chemist, M. Schlœsing, of Paris, and M. Roland, of the same city. They introduced very considerable improvements into the process, but were so much hampered by the State monopoly for salt existing in France that they gave up the manufacture. Later on MM. Margueritte and Sourdeval, of Paris, and Mr. James Young, of paraffin celebrity, patented fresh improvements, and in 1867 Messrs. Solvay and Co., of Couillet, in Belgium, already exhibited soda made on a manufacturing scale by the ammonia process. The last improvements made by that firm, and further on by Mr. Honigmann, of Aachen, and Professor Gerstenhöfer, of Freiberg, seem to have brought the process to such perfection, that in this country, as above-mentioned, but to a much larger extent in Germany and Switzerland, many factories are in the course of erection, one of them for a production of nearly 100 tons of soda-ash per week. Unfortunately, it is as yet kept a secret which are those particular improvements that have made the process a success, but it is not likely that such a secret will be kept very long. As everybody knows, the process consists in saturating a strong solution of common salt with ammonia and carbonic acid at the same time, thus producing bicarbonate of soda as a precipitate and a solution of ammonium chloride, from which the ammonia is recovered again. All chlorine is wasted in the shape of calcium chloride, and for this reason alone the process, in this shape at any rate, could not do away with the ordinary process, for chlorine products surely will be required as much as ever. Possibly that objection might be overcome by substituting magnesia for lime, and converting the magnesium chloride into magnesia and hydrochloric acid again, but that is rather in the future. If the ammonia process really should be the process of the future, it is quite evident that those localities will have the best chance for it where strong brine is to be had for next to nothing, and that the manufacture of alkali will shift to different localities from the present. I do not mean to frighten any of my hearers with this hint, but only to exhort them to keep a sharp look-out for what is doing elsewhere, and by using every care, and adopting every improvement in the present process, which has so far outlived every other proposal, to make it able to compete with any other process in future as well.

NOTES AND QUERIES.

Benzole.—500 gallons of Scotch crude naphtha yield 25 per cent of distillate at 120° C. I should be glad to know how much refined benzole, yielding 90 per cent of distillate at 120° C. it should have produced. Theory and practice appear to disagree.—Scotia.

Zinc and Chromium Greens.—Could you obtain for me any reliable information concerning the manufacture of zinc green and chromium green for paint. Large quantities are yearly imported from Germany, and but little is known on the subject in this country. A reference to any articles which may have appeared in your paper or any other would kindly oblige.—E. D.

MEETINGS FOR THE WEEK.

Monday, Jan. 12.—Medical, 8.
— Geographical, 8.30.
Tuesday, 13.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."
— Civil Engineers, 8.
— Anthropological 8.
— Photographic, 8.
Wednesday, 14.—Society of Arts, 8.
Thursday, 15.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8.30.
— Royal Society Club, 6.
— Chemical, 8. Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (No. V., On Ethyl Bromide)." Dr. M. D. Tommasi and R. Meldola, "On the Action of Trichloracetyl Chloride upon Amines (No. I., Action upon Aniline)."
Friday, 16.—Royal Institution, 8. Weekly Evening Meeting.
— Royal Institution, 9. Prof. Tyndall, D.C.L., LL.D., F.R.S., "On the Acoustic Transparency and Opacity of the Atmosphere."
Saturday, 17.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant."

TO CORRESPONDENTS.

Erratum.—Vol. xxviii., p. 282, line 4 from top, *for* "Traverella" *read* "Traversella."

R. S.—"Select Methods in Chemical Analysis." Apply to our publisher. The price is 12s. 6d.

E. L. Gowthorpe.—"Chelt" will probably see your advertisement; we cannot insert your reply to his query.

BOOKS RECEIVED.

Substance of the Work entitled Fruits and Farinacea the proper Food of Man. Edited by Emeritus Prof. F. W. Newman, for the Vegetarian Society. Manchester: John Heywood. London: F. Pitman.

Questions in Chemistry and Natural Philosophy. Given at the Matriculation Examination of the University of London from 1864 to June, 1873. By C. J. Woodward, B.Sc. Simpkin, Marshall, and Co.

The Ocean: its Tides and Currents and their Causes. By W. L. Jordan. Longmans, Green, and Co.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
Vol. XXIX. No. 737.

NOTICES OF BOOKS.

Milk-Analysis: a Practical Treatise on the Examination of Milk and its Derivatives, Cream, Butter, and Cheese. By J. Alfred Wanklyn. London: Trübner and Co., 57 and 59, Ludgate Hill. 1874.

Until recently the analysis of milk had been in anything but a satisfactory condition, as may be judged of by reference to Goppelsröder's elaborate paper, published in Switzerland in the year 1866, and as, indeed, is quite notorious.

In the little work before us Mr. Wanklyn endeavours to do for milk-analysis that which he, in conjunction with Chapman and Smith, has already done for water-analysis. The book in question is designed specially for the use of the public analysts and medical officers of health; but we think it will have interest even for chemists who are not public analysts, and who are not called upon to make analyses of milk, inasmuch as the same methods which are applicable to milk are also applicable to other things.

The first problem which the author appears to have set himself in connection with the subject in hand was to get hold of a first-rate quantitative datum, which is easily attainable, and, at the same time, available for the purpose in view.

Such a datum, possessing these requisites in an eminent degree, was found in the total solids of milk. With the modifications made by Mr. Wanklyn this datum is rendered first-rate in a quantitative sense, inasmuch as the taking of milk-solids is made to rival the estimation of sulphuric acid or chlorine in accuracy. It is easily attainable, for the ordinary medical practitioner may be readily taught to make these estimations of milk-solids. And when obtained it is *available* for the purpose in view, since a knowledge of the yield of milk-solids alone—not supplemented with anything else—was enough to convict half of the milk-supply to London of being watered.

The determination of milk-solids with accuracy and ease forms the basis of Mr. Wanklyn's method of analysing milk. Having done this, the next operation is the extraction of the fat, which is effected by means of ether. Our readers will recollect a little note on this operation in the last No. of the Chemical News (Vol. xxix., p. 3).

Having ascertained these two facts, viz., how much total solids and how much fat, the task of the milk analyst is usually accomplished, for by help of these two data he is in a position to pronounce upon skimming and watering, and these are the usual forms of malpractice in the milk trade. Persons who have not looked into the question will be surprised to find how very constant is the composition of milk; and, from this treatise, it appears that there is an exceedingly constant factor in milk. This factor is the "solids not fat." It further appears that the ratio of "solids not fat" to the water naturally present is the same in whole milk, cream, and skimmed milk. The book ends with Chapter xv., entitled, "Poisonous Milk and Milk Panics." In this chapter it is set forth that the recent "frightful outbreak of typhoid fever in Marylebone," as it was called by the newspapers, was not in reality an outbreak of typhoid fever at all, but an outburst of panic, and, in point of fact, a doctor's panic.

Oscillation's Regulator. Von Robert Runqvist, Ingenieur in Stockholm.

This pamphlet gives a description of the principles, construction, and uses of a patent machine for regulating oscillation. It is particularly recommended for marine engines, for regulating water-wheels, and for turning- and sewing-machines which are driven by steam, as also for telegraphic apparatus. This invention appears to have gained very favourable notice at the Vienna Exhibition.

CORRESPONDENCE.

ATOMS.

To the Editor of the Chemical News.

Sir,—In reference to "Atom's" last letter, I may remark that my reason for applying the term *Greatest Common Divisor System* to one of the modern views of chemistry which co-ordinates the known facts and expresses them symbolically without assuming anything whatever as to the nature of matter, is that this system is founded on the ascription to each element of a numerical value which is the greatest common measure of the different weights of that element obtainable from a constant volume (under constant circumstances) of all its gaseous compounds severally: for a development of this, *vide* Chemical News, vol. xxviii., p. 25. Probably "Atom" would call this number an *Atomic* number, as it represents a certain weight and a certain volume entering into combination in every instance; but the ideas connoted by this use of the term *atom* are not the same as those referred to by Leucippus, Dalton, and the modern physicists; and hence this use is apt to lead to confusion of ideas,

The President of the Chemical Society may safely be trusted to defend his own phraseology in case of need: I understand the paragraph referred to, quoted from his article on "Atomic Weights," as indicating a two-fold and partly contradictory use of the term *atom*; the one "materialistic" sense *explaining* the occurrence of proportional numbers by means of a special hypothesis, viz., that ultimate material particles of various kinds exist having such and such relative weights; the other, or "abstract" sense having no necessary reference either to this hypothesis or any other, but simply indicating the bare fact that proportional numbers exist without offering any *raison d'etre* for their occurrence.

As a matter of fact, I have no doubt whatever that the use of the term *atom* in senses connoting entirely different ideas is productive of great perplexity and confusion of thought not only in chemical tyros, but in students of a far older growth; but even if this difficulty did not exist, or were ameliorated by careful explanation, it does not seem either philosophical or desirable to employ words in senses which lead to contradictory and diametrically opposed statements in the various manuals of chemistry and scientific papers.—I am, &c.,

C. R. A. Wright, D.Sc.

St. Mary's Hospital, Paddington, W.,
Dec. 30, 1873.

ON THE ADJUSTMENT OF VOLUMETRIC SOLUTIONS.

To the Editor of the Chemical News.

Sir,—In a former communication I indicated a simple means of adjusting volumetric solutions without the trouble of measuring the liquid litre by litre, and I am glad to find that the method, which affords much facility where large quantities have to be made at a time, has been appreciated by many of my friends among your readers. I therefore think it worth while to correct a slight cause of inexactitude which occurs in my former communication.

I ought to have added a method of compensation for the very slight error caused by the withdrawal of the second trial test. To be quite correct one must proceed as follows:—

Suppose it is required to make a test-solution of chloride of sodium capable of precipitating exactly 1 grm. of pure silver for each 100 c.c. of solution, and that it be requisite, as often happens in an assay office, to make a considerable volume of solution at once. The containing reservoir—be it a copper vessel, carboy, or what not—is well cleaned out and drained dry. I now take a clear filtered and saturated solution of common salt, and add it to some water placed in the reservoir; and let us suppose that, on taking a trial sample, I find the salt solution so produced to be too strong. Suppose that we find, on experiment, that 80 c.c. of the solution precipitate exactly 1 grm. of silver. It is obvious that, to bring this solution to the correct strength, it wants a further addition of 25 per cent of its volume—250 c.c. per litre. I now proceed to add a known volume of water, say 1 litre, having previously withdrawn a small sample, say 200 or 300 c.c., from the liquid in the reservoir. This sample I set aside for my future correction to be made. Suppose I find that now 81·25 c.c. of solution precipitate exactly 1 grm. of pure silver. The addition of the water has then made a difference of 1·25 per cent, or 12·5 c.c. per litre; if then we divide the quantity added (in the present case 1 litre = 1000 c.c. of water) by 125, we obtain the number of litres the vessel contained before the second example was taken, viz., in this case, 80 litres. Now, by the first experiment it was found that 250 c.c. per litre, = 25 per cent, were required to adjust the strength of the solution, and we have just added 1 litre. There then remains to be added (80 × 0·25) − 1 litre, *i.e.*, 19 litres.

I now count how many cubic centimetres of liquid I withdraw for the second test-trial. Suppose it in this case to have been 200 c.c. I then take the portion of the first solution which I set aside, and add to it water in the proportion of 12·5 c.c. to a litre. Supposing I had set aside 300 c.c., the quantity to be added would be 3·75 c.c. I measure off 200 c.c., = the portion withdrawn for the second test-trial, and add this to the liquid in the reservoir, when, providing the measurements and titrations have been exactly performed, the solution is brought to mathematical exactitude. Besides this, I become further aware that I have 100 litres of solution in my reservoir.

Had the solution been too weak instead of too strong I could have calculated, in a similar manner, the quantity of salt water that would have had to be added to increase the strength to the right point. The same method serves for every kind of volumetric liquid that can be made.

While on the subject of volumetric testing, I may mention a method used in our new process for refining sugar with tribasic phosphate of ammonia and hydrate of baryta. In this process it becomes necessary to ascertain with accuracy the respective quantities of sulphuric acid and lime which a given syrup contains.

A solution of soap test-liquor is prepared with oleate of potassium, and its strength is adjusted on a solution of barium nitrate containing 13·05 grms. of that salt per litre: 1 c.c. of such a soap test-solution is equivalent to 0·0028 grm. of calcium oxide. We prefer the barium nitrate for adjusting the soap test-liquor, on account of its being so easily obtainable in a state of purity and anhydrous, and also on account of the high equivalent barium salts possess as compared with calcium salts.

First of all we estimate the amount of calcium oxide in a sample of the syrup with our soap test-solution in the usual manner, and note the amount, and then, having added to another sample of the same syrup a measured volume of barium nitrate, more than sufficient to precipitate all the sulphuric acid, we again test the mixture with our soap solution, and were there no sulphuric acid present we should this time be obliged to add as much soap-liquor as we added of barium solution, together with the quantity of soap solution corresponding to the calcium oxide originally in the syrup: as, however, there always is some sulphuric acid in all raw sugar, this throws down and renders inert its equivalent of barium, reducing proportionately the quantity of soap solution we have to employ. By estimating the amount of this diminution of the soap solution required, and counting for each centimetre cube 0·004 grm. of anhydrous sulphuric acid, we obtain the proportion of this latter which the syrup contains, as well as the quantity of calcium oxide already estimated.

Example.—Suppose that a sample, 300 c.c., of a syrup require 7 c.c. of soap solution to produce frothing = 0·0196 grm. oxide of calcium, = 0·098 grm. per litre. We now add 10 c.c. of barium solution, this being found to be more than what is requisite to precipitate all the sulphuric acid and leave a little barium in excess. Were there no sulphuric acid present we should be obliged to add 17 c.c. of soap solution, in order to produce frothing. As it is, however, suppose we find that only 9·5 c.c. is required, then 6·5 c.c. is the quantity of barium nitrate solution which has become sulphate, and—

$$6{\cdot}5 \times 0{\cdot}004 = 0{\cdot}026.$$

By the first experiment on the syrup with the soap test-solution we found 0·098 grm. oxide of calcium per litre, and, on the other hand, we find 0·0260 of sulphuric acid capable of combining with 0·0182 of oxide of calcium.

The syrup then contains 0·0442 grm. sulphate of calcium per 200 c.c., = 0·2210 grm. sulphate of calcium per litre, and 0·0798 grm. oxide of calcium per litre.

This mode of estimating both calcium oxide and sulphuric acid, when in solution together, is applicable in many cases; and not necessitating filtrations and boiling, it forms, in many instances, a most convenient mode of estimating sulphuric acid in combination.—I am, &c.,

F. Maxwell Lyte.

Laboratoire, 6, Cité de Retiro, Paris,
December 21, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 24, 1873.

On some Phenomena of Illumination.—M. Lallemand.—All the effects of illumination in transparent bodies traversed by natural or polarised light may be explained by supposing that the vibratory movement of the ether, penetrating the medium, experiences a resistance in virtue of which the vibrations are propagated laterally in such a way that, in a direction somewhat oblique to the incident ray, the movement of the ether particle represents the projection of that animating the ether in the passage of the luminous bundle; and, on the other hand, that the molecules of the medium, absorbing a part of the *vis viva* of the ether, vibrate in their turn, and propagate, in the etherised fluid, the complex vibrations forming natural light. Illumination, then, is the result of two superposed effects, and the emanating light is formed of two kinds of rays—some, which are always of the same colour as the incident rays, are partly or completely polarised, according as the incident bundle is natural or polarised; others, whose refrangibility is often inferior to that of the exciting rays, have the properties of natural light, and produce *fluorescence.* This fluorescence is a general property of transparent bodies. Using the purest liquids (as those from condensation of sulphurous acid gas, cyanogen, &c.), the illumination is not extinguished when one looks in a direction normal to the bundle and to the plane of polarisation of the incident light, or, if natural light is used, and it is observed through a bi-prism, one of the two images never quite disappears. Among crystallised substances, quartz and rock-salt do not show the least trace of fluorescence, and they are distinctly illuminated. The author polarises a bundle of solar rays with a Foucault prism, and concentrates it with a lens of quartz cut parallel to the axis. The principal sections of the polariser and lens are made to coincide. If the bundle thus concentrated traverses the quartz, either in the state of the ordinary ray or of the extraordinary, one observes in the plane of polarisation a distinct white trace, which is quite extinguished with a Nicol. Looking in a direction normal to the plane of polarisation, the illumination is *nil*; and there is not the least trace of fluorescence. When the ray traverses the quartz in the direction of the optic axis, the dispersion of the plane of polarisation has for result an equal illumination about the ray, and the polarisation is complete only in a direction normal to the bundle. There is no chromatic illumination, only a uniform grey tint. Pure rock-salt, as well as quartz, may be thus illuminated, and is not fluorescent. It is different with Iceland spar; all the specimens examined were illuminated orange-red, but the illumination is the same in the plane of polarisation and at right angles to this plane. It is not extinguished by a Nicol, when the emergent rays are superposed. The orange-red is due to fluorescence, and the polarised illumination is not appreciable. The fluorescence due to the ordinary ray appears of a deeper red than that of the extraordinary. Colourless fluor-spar unites the two distinct properties of quartz and (Iceland) spar in greater intensity; it gives a white illumination, very vivid in the plane of polarisation, and a violet-indigo fluorescence in the perpendicular direction. These three crystallised substances—quartz, spar, and fluorine—represent, from the illumination-point of view, three types, to which all transparent bodies may be referred. To cite an example not previously remarked, pure naphthalin, dissolved in alcohol or rectified essence of petroleum, has a quinic fluorescence of bright indigo-blue. Curious effects are obtained with prisms of hardened glass; the thread of polarised light traversing them gives a luminous trace, which is white and partly polarised at certain points, while at other points it is natural and coloured yellowish-green or bluish-green according to the fluorescence of the colours used, these effects depending on the double refraction of the luminous ray and the direction of the plane of polarisation of the illuminating bundle. The author adds some remarks on the photospheric experiments by means of which he measured the proportion of polarised light in rays emitted by a liquid illuminated by a bundle of rays of natural light.

Observations on the Increase of Volume of Water under 4°.—(*Apropos* of M. Mondesir's note).—M. Hement.—Dilatation is, in general, a phenomenon in which the molecules of a body remove from each other without altering its form, these molecules still having the same relative positions. The expansion of water under 4° presents nothing analogous. The molecules continue to approach under the influence of reduced temperature (this must be a general effect); the pores constantly diminish, but intervals of another nature are produced in the water from 4° to zero. Suppose a vessel in which pins are arranged in layers, so that there is the least possible empty space. If the vessel is inverted, and the pins are spread out, they are entangled with each other in all directions, and may occupy a greater volume than that of the vessel. We may compare the crystalline needles of ice to these mixed pins; each needle is, so to speak, a brochette of molecules, in which the molecules are nearer to each other than they were before crystallisation. It may be said that, crystallisation taking place only at zero, it is only then that this state of things can occur, whereas the augmentation commences from zero. But it is at 4° the molecules commence to arrange themselves in suitable order; the change of state is not an instantaneous phenomenon, but prepared in advance.

Letter from M. Poëy (to M. Elie de Beaumont) on the Relation between Solar Spots and Hurricanes of the Antilles, the North Atlantic, and the Southern Indian Ocean.—The writer furnishes a table of 357 hurricanes (between 1750 and 1873) originating in the northern intertropical region, in the neighbourhood of Bermudas and the Cape Verde Islands, and extending to Europe. *En resumé*, in the last century and a quarter we have twelve maximum periods of hurricanes, of which ten correspond to maximum periods of solar spots; and eleven periods of minima, of which five correspond, similarly, to minima of spots. As to absolute intensity of hurricanes, one also finds an agreement with the solar spots. It is worthy of remark that the hurricanes traversing the island of Cuba in October are generally the most intense, and reach Western Europe most directly; the others are dissipated towards the polar regions. The memorable hurricanes of 1751, 1780, and 1837 all occurred in October. Now the mensual distribution of solar spots, according to M. Wolf, presents its first maximum precisely in this month, and a second maximum in December and January, corresponding to the maximum of winter tempests in high latitudes. The writer further finds the same agreement as regards the periods of 55 or 56 years pointed out by MM. Fritz and Wolf, the last maxima having been in 1837 and 1779. 1837 shows thirteen cases of hurricanes (the *maximum maximorum* for a single year), and twenty-nine cases in 1837 to 1839. 1780 shows seven cases, and there were twelve in 1779 to 1781. The years 1780 and 1837 are also maxima in terrestrial magnetism and polar auroras. The writer next examines the unexpected exception of the sun-spot maximum of 1860, where the table does not present any case of hurricane. He has recourse to a recent discovery, by MM. De la Rue, Stewart, and Loewy, viz., that when the photosphere is subject to great perturbations, the spots change alternately from the northern to the southern hemisphere, and *vice versa*, in the mean period of 25·2 days. May we conclude, he asks, from the fact that the solar perturbation of 1860 was principally limited to the austral hemisphere, that this circumstance may have had some influence on the rarity, or even absence, of hurricanes in the intertropical region of our hemisphere, while, in the same region of the austral hemisphere and of our antipodes, M. Meldrum has ascertained thirteen cases of storms in that year, and for the preceding year the high maximum of fifteen cases? It remains for enquiry whether other solar perturbations, as those in 1869 and 1872, in which years there were no hurricanes, were not also in the austral hemisphere. If this hypothesis should be confirmed, the rarity of hurricanes in our intertropical region might reveal the existence of solar perturbations, the transport of spots to the austral hemisphere, and the abundance of hurricanes in the southern Indian ocean. P. Secchi has found meridians which distinctly give maxima, and others minima, of protuberances.

Observations Apropos of M. Reye's Note on the Analogies between Solar Spots and the Whirlwinds of our Atmosphere.—M. Marié Davy.—The author somewhat defines his opinions on the cyclonic movements in the sun, and considers that M. Reye's objections are not sufficient to invalidate M. Faye's theory of the spots.

Note on Terrestrial Cyclones and Solar Cyclones.—M. de Parville.—The two contrary opinions of M. Faye and M. Reye appear to the author too absolute. Each cyclone shows separately, by its direction of rotation, whether it is ascending or descending. If its direction is opposite (inverse) to the hands of a watch (which occurs in the northern hemisphere), it is ascending; if the same, it is descending. The direction of rotation is determined by the ascent or descent. Bandrols do not give a sure index, whether the vertical component of the wind is ascending; but the barometer does, presenting a fall in the ascending current and a rise in the descending. Thus, the direction of rotation of cyclones, and the fall of the barometer before complete generation of the meteor, seem to furnish two decisive arguments against the theory of descending movements of equatorial cyclones with inverse movement maintained by M. Faye. As to waterspouts, M. Faye argued that, if the alimentation were from below, the meteor would lose its force as its lower end neared the earth, which is contrary to fact; but M. de Parville considers that the very narrowing of the orifice of supply must increase the velocity of flow. M. Faye attributes whirlwinds to differences of velocity in two neighbouring parallels; M. de Parville thinks they arise from the rupture of equilibrium in the vertical, determining affluxes with inverse velocities. Similarly in the sun, especially where there might be an attraction of gas from periphery to centre to fill a vacuum produced by an ascending current, a whirlwind with inverse rotation would be generated. A divergent gaseous mass would generate a whirlwind with direct rotation. M. Faye objects that, if the spots were produced by convergent affluxes, there would be attraction of the gas of the solar equator to the middle parallels, and deviation in the direction of rotation; now the angular velocity of rotation is maximum at the equator. It is replied that the rotation is only measured by the movement of the spots; the variation of real velocities in the different parallels escapes observation, but the angular velocities ought to diminish for the spots, according to the law of rotation formulated by Carrington and others. It has not been sufficiently considered that, whatever the velocity of gases at the equator, every afflux rising towards the middle parallels diverges in the direction of rotation; every descending afflux, on the other hand, diverges in the opposite direction. The *vis viva* of these affluxes is employed almost wholly in turning the mass of intermediate gas, which continues to follow its course with a velocity nearly equal to that of the parallel in which it is. The analogy of trade-wind circulations is thus not inapplicable to the sun. The temperature of the air being high over continents, the rupture of equilibrium and the descending flow will take place principally on the sea. About this axis in the middle of the ocean, there will be a general circulation in our atmosphere from left to right, and this agrees with observation. Again, the air is forced from its maximum of pressure towards the poles, and generates in its ascending movement a south-west wind with vertical component. The south-west wind in our latitudes is rising, instead of descending, as meteorologists maintain; otherwise the barometer would rise instead of falling. This ascending afflux produces a new gyratory movement with inverse rotation, but not so well determined as the preceding, because the axis is incessantly displaced. This represents the south-west wind of our countries, and the north-west of the American coast. The afflux of ascending air from high regions may produce whirlwinds at the limits of the atmosphere, but with a direction of rotation opposite to that of the whirlwinds of maximum pressure.

Apparent Orbit and Period of Rotation of the Double Star ξ of the Great Bear.—M. Flammarion.

Discharge of Electrified Conductors.—M. Montier.—The author offers some mathematical considerations, from which may be demonstrated a theorem established by Gauss and Lionville.—When conductors contain respectively equal quantities of the two fluids, all these conductors are in the natural state. The potential is *nil*; consequently the exterior discharge of the system cannot produce any work.

Variable State of Voltaic Currents.—(Reply to M. Cazin).—M. Blaserna.

Application of Phosphate of Ammonia and Baryta in the Purification of Saccharine Products.—M. P. Lagrange.—The modes of purification at present employed in sugar-works are almost all based upon the action of lime and its subsequent elimination by means of carbonic acid. They all leave in the saccharine products a certain proportion of organic matters and of mineral salts which, to a certain extent, prevent the crystallisation of the sugar. These bodies are the cause of the formation of treacle and of the loss of sugar in residues. The author proposes to eliminate the organic salts of lime, the potassa and soda salts of certain vegetable acids, and the alkaline sulphates by combining the action of baryta and of phosphate of ammonia. In operating upon syrups it is necessary to keep them alkaline or the crystalline sugar becomes transformed into glucose. At present sugars and syrups are kept alkaline by lime, which not only exists in a soluble state in these products, but combines with vegetable acids to form very stable lime salts. These salts are not decomposed by carbonic acid, which, however, removes lime dissolved in the sugar. These organic lime-salts occasion much trouble in every stage of the sugar manufacture. Animal charcoal, in the proportion in which it is employed, does not effect their absorption. The author uses for their decomposition basic phosphate of ammonia. Phosphate of lime is formed and ammonia set free. The juices and syrups thus freed from lime would quickly become neutral and acid. Baryta or sucrate of baryta is therefore used to complete their purification. The baryta has a twofold action. It decomposes the alkaline sulphates, forming sulphate of baryta, and also several organic salts of potassa and soda, giving rise to compounds insoluble in an alkaline medium. This liberation of potassa and soda not only favours the insolubility of the organic salts of baryta, but serves to maintain the alkalinity of the syrups freed from lime. In the extraction of sugar, syrups are generally treated at 20° Baumé, having generally undergone the carbonic-calcic treatment. The product is placed in a steam-jacketted boiler and phosphate of ammonia is introduced equivalent to the lime, the quantity of which must be previously determined, so that not more than 1-10th per cent may be left in the syrup, an amount which the animal charcoal is able to absorb. Baryta is then added in proportion to the alkaline sulphates and the organic matters, of which not more than 1 per cent should be allowed to remain. The whole is raised to a boil and thrown upon Tayler's filters. The purified syrup as it drains from these falls upon granulated bone-black, leaving in the filters a precipitate valuable as manure. In refining, the purification is made in the boiler in which the raw sugar is melted. The finely-ground bone-black and the blood are suppressd and phosphate of ammonia, previously dissolved, and equivalent to the lime, takes their place. Then a solution of baryta is added in proportion to the alkaline sulphates and organic matters in the sugar, leaving the syrups faintly alkaline.

Zeitschrift fur Analytische Chemie, von Dr. C. R. Fresenius, Zwölfter Jahrgang, Zweiter Heft, 1873.

Presence of Quercetin and Quercitrin in Catechu and Sumac.—Julius Löwe.—Both these bodies appear, according to the author's experiments, to be present in various kinds of catechu and sumac, though in very small quantities.

Tannin of Sumac.—Julius Löwe.—The author previously expressed the opinion that (*Zeitschrift für Analytische Chemie*, vol. xi., p. 365) the tannin of sumac is distinct from that of nut-galls. After a careful examination he now pronounces them identical.

Determination of Potassa.—Dr. F. Mohr.—The platinochloride of potassium can only be weighed as such upon the filter, an equal degree of exsiccation being, of course, necessary. Such weighings upon a counterpoised filter are always unsatisfactory, whence it is preferable, whenever possible, to burn the filter. The smaller the amount of the platinum salt, the greater the errors are possible. The author therefore endeavours to determine the amount of potassa by titrating some substance contained in the salt; as such, he naturally selects the chlorine. The platinochloride is only partially decomposed by heat, a part of the chloride of platinum being apt to remain untouched; on the other hand, the salt is readily decomposed if heated to fusion in a platinum crucible with twice its weight of oxalate of soda. After lixiviation, the chlorine can easily be determined by a decinormal silver solution.

Volumetric Analysis of Free Oxygen.—Dr. F. Mohr.—An examination of Schützenberger's method with the hydrosulphite of soda. The author recommends a solution of ferric chloride, or of iron-ammonia alum, with sulphocyanide of potassium as indicator, for standardising the hydrosulphite solution. He covers the reducing liquid in the burette with a layer of benzol of from 5 to 10 m.m. in depth, and reads off at the line of separation of the two liquids, which is almost horizontal, and can be read very distinctly. Dr. Mohr remarks that the entire process involves a certain *petitio principii*—the assumption that the reducing liquid acts in the same manner upon the oxygen of ferric oxide as it does upon free oxygen. The oxidisability of hydrosulphurous acid is so great that even the height from which the drops fall, and the size of the surface, have a perceptible influence.

Analysis of Galena.—Dr. F. Mohr.—Storer's process consists in decomposing the galena in contact with zinc, sulphuretted hydrogen being given off, and metallic lead set at liberty. Hence it might seem that contact with zinc was necessary, and that the disengagement of sulphuretted hydrogen was a consequence of its presence. This is not the case. Pure finely-ground galena is completely decomposed by common hydrochloric acid, with development of sulphuretted hydrogen and formation of chloride of lead. The action, however, is soon stopped by the precipitation of chloride of lead upon the galena, and by the saturation of the acid with chloride of lead. The action of the zinc removes these inconveniences. It is generally supposed that the sulphide of lead, as precipitated by sulphuretted hydrogen, is insoluble in acid liquids; this is incorrect. Recently precipitated and washed sulphide of lead is instantly attacked by hydrochloric acid, even in the cold, and converted into chloride of lead, with evolution of sulphuretted hydrogen. It is also known that in very acid liquids—in sulphuric and hydrochloric acids—lead cannot be detected by means of sulphuretted hydrogen. Galena can be completely extracted from mixed ores by hydrochloric acid, and the lead can be deposited from the solution. Copper pyrites yields to boiling hydrochloric acid not a trace of copper, but only a small quantity of iron. Zinc, iron, and manganese, if present, are not thrown down by zinc from acid solutions. It is possible to dissolve galena alone, and to throw down its lead; and Storer's condition, that the galena must contain no other heavy metal, is not essential, with the exception, perhaps, of antimony. The weighing of the lead as metal is practicable, but does not give comparable results. It is most accurately determined as sulphate. With whatever foreign metals (except antimony) galena is mixed in the gangue, the separation of the lead in the state of sulphate can always be effected in the following manner:—2 grms. of finely powdered galena are weighed off, and placed in a small porcelain pan furnished with a handle. It is covered with ordinary pure hydrochloric acid, covered with a convex glass, heated to set free sulphuretted hydrogen, and finally boiled. A large quantity of chloride of lead separates out. When the acid is saturated with chloride of lead, zinc is added in the form of a small ball. Brisk evolution of hydrogen gas commences, and lead is thrown down upon the zinc. By the aid of a gentle heat, fresh quantities of chloride of lead are dissolved and decomposed, until the liquid appears clear and colourless, and the evolution of sulphuretted hydrogen ceases. The liquid is poured off, and the lead thoroughly washed with pure water in the capsule. The decantation is safe and easy, on account of the high specific gravity of the lead. Dilute nitric acid is poured upon the lead while still moist, and heat is applied till the metal is dissolved, when nitrate of lead is separated if the amount of water present is insufficient. The nitrate of lead is dissolved by water and the application of heat, the liquid is filtered, and the filter washed with hot water. In the filtrate, the lead is thrown down by the addition of distilled sulphuric acid in large excess, and heated for a time, when the sulphate of lead is deposited in a dense form. When cold, the whole is filtered, the precipitate washed with dilute sulphuric acid and finally with a little alcohol, dried, and the weight of the sulphate of lead determined after incineration of the filter. The filtrate when saturated with ammonia shows scarcely a trace of brown colouration with sulphuretted hydrogen.

Swedish Filter-Paper.—Dr. F. Mohr.—The author shows that Swedish filter-paper is now undeserving of its high traditional reputation, and that it contains soluble alumina.

Arrangement for Preventing the Escape of Offensive Gases in Laboratories.—Dr. F. Mohr.—The author passes the gases through a two-necked Wolff's bottle containing milk-of-lime, and allows the residue to escape through a funnel filled with fragments of lightly-burnt wood-charcoal the size of a nut.

Correction of the Weight of Platinum Crucibles.—Dr. F. Mohr.——Instructions for the use of a counterpoise, instead of weighing the empty crucible after use.

Experiences in Chemical Jurisprudence.—H. Struve.—The author discusses minutely the methods for detecting nicotin and colchicin in cases of poisoning, also the reactions of morphia, piperin, brucin, strychnin, and daturin.

Behaviour of Chloride of Silver with Concentrated Sulphuric Acid and with Solution of Perchloride of Iron.—A. Sauer.—It is commonly stated that chloride of silver is not attacked at all, or but very slightly, by concentrated sulphuric acid. This is incorrect. If chloride of silver, either recently precipitated and washed, or crystallised, or fused, is heated for some time with concentrated sulphuric acid in a covered porcelain capsule, the chloride of silver is decomposed and dissolved, with escape of hydrochloric acid. Chloride of silver is also soluble in solutions of perchloride of iron, a circumstance which should not be lost sight of in determinations of silver.

A New Application of Kempf's Washing-Bottle.—A. Sauer.—The author applies this bottle in preserving solutions of protochloride of tin from contact with the air.

Appendix to the Paper "On a Method of Determining Sulphur of General Applicability."—A. Sauer.—The author furnishes the results of analysis in proof of the value of his method. He adds the caution that the sulphur in crude iron cannot be determined on this principle. In determining the sulphur in coal, lignite, &c., he employs not carbonic acid, but common air; in case of bisulphide of carbon and coal-gas it is necessary to use carbonic acid. In order to absorb the vapours of bromine that pass over, and for the certain absorption of the sulphurous acid, the author employs a second ball, U-tube, containing very dilute hydrochloric acid. This readily dissolves the bromine that passes over, and if no sulphuric acid is present in the last U-tube, the bromo-hydrochoric acid may be used again.

Apparatus for the Quantitative Determination of Fats.—E. Simon.—This paper would not be intelligible without the accompanying illustration.

Improved Apparatus for Quantitative Analysis.—A. Gawalovski.—The author describes an apparatus for concentrating filtrates, &c., without delay and without loss, and a syphon for drawing off liquids that emit acid or ammoniacal vapours, &c. The descriptions could not be distinctly understood without the illustrations.

Determination of Chlorine in Presence of Sulphurous Acid.—R. Messell.—In volumetric determinations of the chlorine or hydrochloric acid in the chimney-gases of soda-works, the author found that chlorine cannot be determined when in presence of sulphurous acid by Mohr's method, *i.e.*, in a neutral solution with chromate of potassa for indicator. If only small quantities of sulphurous acid exist in solution, a red colouration of chromate of silver appears, which, however, gradually disappears again. The final reaction does not appear until all the sulphurous acid has been precipitated as sulphite of silver.

Determination of the Granular Density of Gunpowder.—Dr. E. Luck.—A lengthy paper, rather of a physical than chemical nature.

Determination of Chrome in Chrome Iron.—F. C. Phillips.—According to A. Mitscherlich, most obstinate minerals can be decomposed and dissolved by heating them with sulphuric acid in closed glass tubes. In case of chrome-iron it was found that sulphuric acid of the specific gravity of 1·34 at temperatures between 250° to 300° C., gave the best results; 8 c.c. being sufficient for ½ grm. of the ore. If a solution of a salt of chromic oxide is mixed with carbonate of soda in excess, and bromine-water is then added drop by drop, with constant stirring, the chrome dissolves as chromate of soda. A number of experiments proved that the separation of chromium in this manner from zinc, manganese, iron, and alumina, is complete. Alumina, however, is less easily treated than the others. The solution must be much diluted, and must contain only a slight excess of carbonate of soda. Heat is not applied until *after* the addition of bromine.

Chemico-Technological Gas Analysis.—M. Winkler.—The author treats of the determination of oxygen, nitric oxide and nitrous acid, chlorine, hydrochloric acid, ammonia, sulphuretted hydrogen, and carbonic oxide.

Pressure Regulator, for Determining Boiling Points.—Lothar Meyer.—This paper could not be understood without the accompanying illustration.

New Exsiccator.—G. J. A. Artope.—The same remark may apply here as in case of the last paper.

Improved Caoutchouc Blowpipe Bellows.—Armin Junge and K. Mitzopulos.

Determination of Melting Points.—E. Kopp.—The author recommends a mercury bath in preference to one of sulphuric acid or of oil.

Application of Sulphide of Sodium as a Blowpipe Reagent.—M. Jean.—The substance to be examined is fused with borax in the reducing flame, a polysulphide of sodium is added, and the whole re-heated in the reducing flame, when according to the metals present either clear sulpho-salts or opate masses of various colours are obtained. According to the author, iron, lead, bismuth, nickel, cobalt, palladium, thallium, silver, copper, uranium, give a brown opaque mass; zinc an opaque white; cadmium a mass yellow when cold, but scarlet when heated; manganese a dirty chesnut brown; gold and platina a clear, translucent, mahogany-coloured; tin a translucent yellowish brown; chromium a green arsenic, and antimony, clear and colourless; vanadium and iridium blood-red.

Cement for Corks.—Otto Facilides.—A syrupy solution of shellac in benzol and one of caoutchouc in the same solvent are prepared separately and mixed together. The cement is said to resist chlorine.

Mixter's Process for the Determination of Sulphur. H. Fresenius.—This paper would not be intelligible without the accompanying illustration.

Detection of Iodine.—Henry and Tilden recommend solution of permarganate for the liberation of iodine, with a view to its subsequent detection by means of starch. The reaction is, however, less sensitive than that of hyponitric acid.

Preparation of Chemically Pure Grape Sugar.—H. Schwartz.—If cane-sugar is dissolved in alcohol of 80 per cent, to which a little hydrochloric acid has been added, after some time grape-sugar separates out in a state of chemical purity.

Determination of Nitrogen in Bodies rich in that Element.—M. Maercker.—The author has compared the results of Will-Varrentrapp's method with that of Dumas and finds that the two agree when the ammonia obtained in the former is determined by means of chloride of platinum. O. Nasse washed out the bulb-tube into a capsule, evaporates to dryness, and titrates the residual chloride of ammonium with nitrate of silver. S. W. Johnson recommends in place of soda-lime a mixture of dry carbonate or sulphate of soda and hydrate of lime.

Quantitative Determination of Asparagin.—R. Sachsee.—The author founds his process upon Knops's method.

Determination of Moisture in Bone-Black.—J. Walz.—The application of a temperature of 121° for four hours, or a period of twenty-four hours in the exsiccator is sufficient to drive off all the moisture.

Test for Balsam of Peru.—G. H. Hager.—The author recommends that 2 to 3 c.c. of the sample should be shaken up with 6 to 8 c.c. petroleum ether and allowed to stand, when it is seperated into a dark brown mass, and a colourless stratum, which can be decanted off. If the sample is falsified this liquid has a decided yellow or brownish colour or opaque, or the dark residue is mobile, and some of it passes over with the clear liquid, or it coagalates speedily after removal of the upper layer, or it does not adhere to the sides of the cylinder.

Detection of Fatty Oils in Ethereal Oils.—F. Rhien.—A flask containing ½ litre is filled to the half with distilled water, and is connected by 2 tubes, bent at right-angles and united with cautchouc, to a smaller flask of 200 c.c. capacity, in such a manner that the longer leg of the tube reaches to the bottom of the smaller flask. Into the latter pour about 100 c.c. of distilled water and from 1 to 10 or 15 c.c. of the sample of oil. The small flask is then connected with a Leibig's condenser. A cylinder graduated in tenths of a c.c. is placed to receive the distillate provided with a bent lateral tube to pour away the water which passes over with the oil. This cylinder is filled to overflowing with distilled water. Everything being thus arranged, the water in the large flask is brought to a boil, which is kept up till all the essential oil is carried off by the current of steam.

There are also a number of notes on zoo-chemical analyses, such as a method for detecting nitrites in the saliva, by means of a mixture of starch-paste and iodide of cadmium; a process for determining the absolute amount of the blood; the detection of cystin in urinary calculi; the dedermination of urea, by means of Millon's reagent; the determination ot sugar in diabetic urine; and the analysis of human milk.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 738.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 17).

I would here ask whether chemists in their analytic analyses sufficiently allow for barometric variation. The temperature at the time of weighing is generally recorded: chemists have known the influence of pressure on the boiling-point, and its effect upon gases, yet they appear to neglect reference to the barometer when weighing solids, forgetting that they are weighing in a gas which itself possesses weight. Weighings are repeated after some operation, such as expelling moisture, at intervals sufficiently long to admit of considerable variation in atmospheric pressure, and the increase or decrease of a few milligrammes in weight is considered to determine the gain or loss of certain constituents. It remains to be seen whether a neglect of variation in barometric pressure would not account for these minute differences.

An approximation to the true weight of bodies, that is, their weight *in vacuo*, may be obtained by the following formula, when their specific gravity and weight in air of 760 m.m. pressure of mercury at 0° C. is known.

Let W = weight in grains; then the weight of air displaced is—

$$\frac{W}{\text{sp. gr.}} \times 0{\cdot}00122.$$

This weight *plus* the value of the weights *in vacuo* balancing the substance is its true weight *in vacuo*.

Let the weight of 800 grains of water in 200 grains of glass be required from two assistants, the one weighing against brass, the other against platinum weights, neglecting (1) the weight of air displaced and (2) its variation in weight from barometric disturbances.

(1). The true value of 800 grains of water weighed in air (bar 760 m.m. 0° C.) = 800·976 grains.

That of 200 grains of glass = 200·0976 grs.
Weight of air displaced by water = 0·976 „
„ „ „ glass = 0·0976 „

A brass weight of 1000 grains in use in my laboratory displaces 0·1462 gr. of air; a 1000-grs. platinum weight, 0·058271 gr. of air.

The weight of glass and water = 1000·0000 grs.
„ „ air displaced by them = 1·9736 „

Weight of glass and water .. = 1001·9736

Glass and water .. .. .. = 1001·9736 grs.
Less air displaced by weight (brass) .. .. = 0·1462 „

1001·8274 grs. =

= the true value of the water and apparatus received from the assistant employing brass weights.

Glass and water .. .. .. = 1001·973600 grs.
Less air displaced by weight (platinum) .. .. .. = 2·058271 „

1001·915329 grs. =

= the true value of the water and glass received from the assistant employing platinum weights.

(2). In a note to the translation of Deschanel's "Natural Philosophy,"* by Professor Everett, it is said, "In strictness the weight in grammes of a litre of air under the pressure of 760 m.m. of mercury is different in different localities, being proportional to the intensity of gravity—not because the force of gravity in the litre of air is different (for though this is true, it does not affect the numerical value of the weight when stated in grammes), but because the pressure of 760 millimetres of mercury varies as the intensity of gravity. So that more air is compressed into the space of a litre as gravity increases. The *weight in grammes* is another name for the *mass*. The force of gravity on a litre of air under the pressure of 760 m.m. is proportional to the square of the intensity of gravity. This is as excellent example of the ambiguity of the word *weight*, which sometimes denotes a mass, sometimes a force; and though the distinction is of no practical importance so long as we confine our attention to one locality, it cannot be neglected when different localities are compared." In one locality we have to deal with differences of air pressure alone. Assumed that we are weighing at Greenwich, where gravity is to that of Paris as 3457 to 3456, the weight of a litre of dry air at Paris being 1·293167 grm. at 0° C. at a barometric height of 760 m.m., the weight of a litre of air at Greenwich at the same barometric and thermometric heights will be 1·293561 grm. Knowing the weight of a litre of air at 760 m.m. barometric height, at a lower height of the mercurial column the weight will be proportionately less, the temperature being supposed constant; so that the weight of air displaced with the barometer at 740 m.m. by the glass apparatus and water will be 1·9216 grs., and at 715 m.m. 1·8890 grs. The brass weight will displace 0·1424 gr. of air at 740 m.m. and 0·1385 gr. at 715 m.m.; the platinum weight will displace 0·56737 gr. of air at 740 m,m., and 0·054666 gr. at 715 m.m. The assistant weighing with brass weights would give then—

Under 760 m.m. an error of 1·8276 grs.
„ 740 „ „ 1·7792 „ } on the 1000.
„ 715 „ „ 1·7505 „

The assistant weighing with platinum weights would give—

Under 760 m.m. an error of 1·915329 grs.
„ 740 „ „ 1·864863 „ } on the 1000.
„ 715 „ „ 1·834334 „

Proceed on another supposition. Let the apparatus be weighed on two days, the barometer readings being respectively 740 m.m. and 715 m.m. Weighed on, say, the first day at 715 m.m., on the second day there would be an apparent increase of nearly 0·029 gr.; and if weighed again on a third day at 760 m.m. an increase of 0·0771 gr., or against platinum weights nearly 0·081 gr.

Had a specifically lighter fluid than water been taken, or exceptional cases exemplified, it would have been possible to have largely increased these numbers; but they are a fair average of the errors unrecognised in ordinary manipulation.

To select another instance. In the determination of the amount of carbonic acid yielded by an organic body under combustion, the weight of the potash and bulbs is always sufficiently great to introduce an error arising from neglect of barometric variation. Thus, taking the potash and bulbs to weigh 600 grains, there would be displaced 0·336 gr. of air at 760 m.m. pressure, 0·327 gr. at 740 m.m., and 0·316 gr. at 715 m.m. Between 715 and 760 m.m. there is an increase of weight of 0·02 gr., or, supposing 3·5 grs. of the substance under analysis had been taken, an increase of nearly 0·6 per cent. Again, a chloride of calcium tube, weighing, with its contents, 350 grs., displaces 0·2135 gr. of air at 760 m.m. pressure. Between 715 and 760 m.m. there will be an increase of 0·0127 gr., or of 0·36 per cent. Thus, in the estimation of the carbonic acid and of the water yielded by the organic body, the total error introduced by barometric variation is

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[*] A Paper read before the Royal Society June 20, 1872.

[*] Part I., p. 141.

nearly 1 per cent. I need not quote illustrations of the effect of such an error upon the formula deduced; it will perhaps account for the difference from theory often obtained in the results of carefully conducted analyses.

The preceding calculations show that a simple formula may be stated which shall include the corrections on a certain volume of air for pressure and for temperature. It is—

$$W = 1{\cdot}293651 \text{ grm. } V \frac{1}{1+0{\cdot}00367\,T} \cdot \frac{P}{760},$$

where W is the weight in grammes of a volume (V) of air at a pressure P and temperature T, 0·00367 being the coefficient of the expansion of air. For accurate experiments, it will be necessary to substitute the weight of a litre of air in the locality of the laboratory for the coefficient of V. The formula, as it now stands, is calculated for the volume in litres; if a cubic centimetre be taken, the coefficient of V becomes 0·001293651; if a cubic decimetre, 0·01293651. For laboratory purposes, the ratio of the pressures might be tabulated; this is scarcely necessary, however, if the ratio 759 : 760 be taken = 0·9987 as sufficiently accurate, for a tabular difference of 0·0013 will enable the operator to speedily determine the ratio he requires.

In particularly describing the vacuum balance, I have one peculiarity to note in relation to the effect of heat in diminishing the weight of bodies. That a hot body should appear to be lighter than a cold one has been considered as arising from the film of air or aqueous vapour condensed upon or adhering to the surface of the colder body, or from the upward currents of air caused by the expansion of the atmosphere in the vicinity of the heated body. But neither hypothesis can be held when the variation of the force of gravitation occurs in a vacuum as perfect as the mercurial gauge will register, and under other conditions which I am now supplying, and which I purpose embodying in a paper to be submitted to the Royal Society during a subsequent session.

(To be continued).

THE VALUATION OF SPENT OXIDES FROM GAS-PURIFYING.

By GEORGE E. DAVIS.

During the last year I have made several complete analyses of the spent oxides from gas-works, and have seen the reports of other chemists mentioning only water and sulphur, it being supposed that they were the only constituents in which the manufacturer of oil of vitriol was interested. Now, although the purifying material is nearly always sent to the gas-works, little else than ferric hydrate mixed with a little sawdust it mostly leaves as a complicated mixture, some of its constituents exerting a very injurious action in the vitriol manufacture. The amounts of these ingredients should be estimated so that the material might be correctly valued. If we suppose the sulphur to be mixed with ferric hydrate only, a sufficient current of air, together with the requisite degree of heat, would eliminate the sulphur to under 1 per cent, calculated on the resulting burned oxide; but when bases are present which combine with the sulphur dioxide, which further produce sulphates when exposed to heat and an oxidising agency, the value of a material would be less in proportion as the bases increase. The only base likely to be present is lime, which may either result from faulty manufacture, or may be added at the various gas-works where the oxide-purifying system is used. The next impurity which acts injuriously towards the vitriol manufacturer is the ammonia, existing in the material as ammoniacal salts. The ammonia, by its action upon nitrogen trioxide, renders it imperative to work with more nitre than is absolutely necessary for the oxidisation of the sulphur dioxide, but these soluble salts can be easily washed out, and valuable ammonia obtained, and it only wants a little management to extract both acid and base in a separate form. It is the lime then which requires to be carefully estimated, and this may be seen by the following analyses:—

	I.	II.	III.
Sulphur	64·376	62·358	67·956
Ferric hydrate	14·421	17·112	15·335
Insoluble	11·052	5·099	8·304
Moisture	2·079	5·387	3·900
Lime (combined with S) ..	2·399	—	—
Sawdust	2·470	1·776	1·002
Calcium carbonate	—	5·135	3·006
Ammonium sulphocyanide ..	2·662	1·324	1·102
„ chloride „ cyanide }	0·605	—	—
„ ferrocyanide ..	—	1·663	—
Iron ferricyanide	trace	0·366	trace
	100·064	100·220	100·605

The following is the analysis of a sample of the burned oxide:—

	Wet.	Dry.
Moisture	15 228	—
Insoluble	28·302	33·386
Ferric oxide	44·420	52·399
Calcium sulphate ..	11·288	13·315
Sulphur	0·762	0·200
	100·000	100·000

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

The subject of this lecture was "Ebullition and Radiant Heat."

The phenomenon of boiling was first considered. When a liquid receives such a quantity of heat, and so rapidly, that its cohesion is so diminished that its tendency to form vapour overcomes the pressure of the air, the liquid forms bubbles of its own vapour, and is said to be boiling. The singing of the kettle, when beginning to boil, is due to the rapid ascent of small bubbles formed at the lower portion of the liquid, which collapse, and the shocks which such collapses give to the air produce musical sounds. Thus a regular succession of bubbles may rise from some rough surface, in rhythmic sequence, more frequently than sixteen times in a second, and produce a musical note. To measure the relation between the pressure of the air and the temperature at which a liquid boils, an instrument called Marcet's boiler is exceedingly useful. It is a strong copper sphere, air-tight throughout, and containing Hg at the bottom and water above. When heat is applied the steam cannot escape, but forces the Hg up a tube—a pressure-gauge—which dips into the Hg, and, while the pressure increases, the increase of temperature is shown by a small thermometer communicating with the heated water or mixed atmosphere inside. At ordinary temperatures water boils at 100° C., but on the top of a hill it boils at a lower temperature. Hence by increasing the pressure the boiling-point is raised, and by diminishing the pressure the boiling-point is lowered. Let us take alcohol, slightly warmed, and diminish the pressure by withdrawing the air which exercises the pressure. One of the three forces which kept the liquid in equilibrium at that temperature has been diminished, so it boils. Similarly water may be made to boil below 100° C., by taking off the pressure of the air which is restraining it. Take a flask of boiling water, from which the air has been forced by the steam, and cool it gently. What happens? The water boils again, by the withdrawal of heat, because the steam is condensed into water, which does not occupy so much space and has not so much tension, thus allowing the water to rise as vapour. So, in the cryophorus, we saw how the condensation of the vapour of water by freezing released the pressure upon the surface of the water in a neighbouring vessel, and allowed the water to evaporate more rapidly, so as to cause it to freeze.

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* Abstract of the fifth of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 15th ult.

That the atmosphere presses seriously on all bodies—that it requires a considerable elastic force in the steam to thrust back the atmosphere pressing upon it—may be simply shown. Take a closed vessel full of steam, and you have the condition of the elastic force of steam exactly taking the place of the pressure of the atmosphere; but remove the pressure of the steam by condensing it, then no restraint is exercised, and the sides of the vessel fall in—collapse.

Different liquids have different boiling-points, as seen in the different vapour-tension of alcohol, water, and ether, when introduced into the barometer. This proneness of different liquids to rise, with varying powers, in the form of vapour, is due in some degree to their chemical composition,—of course depending also on the quantity of pressure; but that is not all. The temperature at which a liquid boils also depends upon the nature of the surface of the vessel in which it is heated. Hence, under ordinary circumstances, water in a clean copper vessel boils at 100° C., but it can evaporate at temperatures below this; and when the containing vessel is of a higher temperature than itself, the liquid assumes a peculiar form called the spheroidal state. If you take a basin made of silver, which is known to conduct heat very well, heat it almost red-hot, and pour a little water into it, the heat radiated from the silver evaporates the lower surface of the water so rapidly that there is a little cushion of steam between the globule of the water and the heat of the plate—the liquid evaporating in the spheroidal state being shown on the screen. This state of water, which thus fails to come into contact with the mass of metal hotter than 100° C., is sometimes supposed to be the cause of boiler explosions. Blacksmiths, in tempering steel, are particular to have the water which they use clean, and such as we generally employ. If the water is soapy, the metal does not touch the water, and is not cooled sufficiently rapidly. Plunge a red-hot copper ball into a solution of soap; on taking it out it will still be red-hot, and you can see, by the glow inside the water, that the two are not in contact. Soap-bubbles are blown by the hot metal, and the space between the metal and the soapy film is constantly occupied by the passage of steam between the two.

We turn now to the chapter of "Radiant Heat." With regard to the rate at which radiant heat travels, the best measurements are those which depend upon the intimate association between light and heat. When the moon passes between the earth and the sun, causing a total solar eclipse, both light and heat are shut off from the earth; the moment the sun becomes visible its heat is felt. This shows that, as far as the distance of the moon from the earth is capable of telling us, heat and light travel at the same rate. The velocity of light is found to be about 200,000 miles a second, and the velocity of heat is concluded to be the same. Now when heat travels by convection, it travels as fast as the body which holds it; when by conduction, it travels at a still lower rate, for it may be reckoned, in the case of a bar of metal, by comparing feet with minutes or hours.

Radiant heat may pass through solids, liquids, and gases; and it passes, as we see, from the sun to the earth, through interstellar space, where there is little or no ponderable matter. Radiant heat passing in the latter manner is supposed, like light, to consist of rhythmic agitation of the particles of a supposed medium called "ether." Some people go so far as to say that this medium pervades also solid and liquid bodies; others suppose that it only pervades stellar space or *vacua*; and when the agitation of this force meets with matter, it communicates its peculiar vibrations to this matter, and these vibrations are carried by the ponderable matter through itself. Conceive a point on a body giving out heat, to be joined by a straight line with a point on a body receiving the heat, and conceive the row of ether particles on that line to be set in motion in a manner similar to the motion of the particles of water when a wave passes along; each particle moving up and down, or to and fro, across the direction of the wave's motion. Such is supposed to be the nature of the ether's agitation when radiant heat is passing through it, and such a line of agitated ether particles is called a ray of heat; a collection of such rays is a beam.

Radiant heat, on striking a body, meets with various fates. Suppose that body to be a solid with parallel sides, then the ray of heat or linear system of vibration striking the surface, which may be smooth and metallic, is cast back or reflected; but if that surface be of wood, some of the heat may be reflected, but for the most part it heats the wood and stops there, warming the mass. If the heat strike some other substance, say rock-salt, it travels through, passing out parallel to its course where it entered. We may suppose three rays of heat forming a beam, and a portion may pass through a body (transmission, diathermancy), a portion may enter and warm it (absorption, athermancy), and a portion may be cast back from it (reflection). That is the fate which awaits a beam in all cases; but when one of these prevail over the others, we call bodies, roughly, transmitters, absorbers, or reflectors, of heat.

A ray of heat which strikes a flat, smooth reflecting surface is so cast back that it makes, after reflection, the same angle with the reflecting surface, or with a perpendicular to it as it did before; and the incident ray, the reflected ray, and the perpendicular to the surface at the point of impact, are all in one plane. To prove that radient heat obeys this law, reference must be made to another means for detecting small quantities of heat, and that means is an electrical one. If two ends of unlike metal bars are joined together, and the other ends connected by a wire, the slightest change in the temperature of the joint causes a galvanic current to pass through the wire. A number of such couples joined together give a thermo-electric battery or pile. The presence of the current, and therefore of the heat which causes it, is judged of by the deflection caused by the current on a neighbouring magnetic needle. If the current pass from south to north above the needle, the northerly end of the needle will turn to the west. By means of a hood, the heat radiated towards the face of the pile is concentrated on them. Place a candle at a certain distance from the pile, and that candle may stand for any length of time without moving the needle, but if a simple tin tube is introduced between the two, the needle quickly turns, showing that the heat has struck the metal tube, has been reflected backwards and forwards, just like sound, and so was concentrated on the face of the thermo-pile.

Two spherical mirrors may be used to show that the law of reflection is true. It is easy to prove geometrically that if the ray of light striking such a mirror parallel to its axis be very near to this axis, the point at which the parallel rays are converged is nearly half the radius of curvature, and inversely the rays coming out from that point will be reflected in lines parallel to the axis. These parallel rays strike the other mirror, and are cast into a second focus, thus forming conjugate mirrors. A red-hot copper ball was placed in one focus and a little gun-cotton in the other, and the heat radiated from the ball and reflected was sufficient to inflame the cotton. In fact, the power of polished metal surfaces to reflect heat is well known, as in the action of a Dutch oven before the fire, and firemen using a polished metal helmet, that the heat may not affect the head, but be reflected.

For some time it was thought that cold is reflected as well as heat, but we do not recognise cold as a thing or a state, but simply as the absence of heat. If a mixture of ice and salt (freezing mixture) be placed in one focus of the spherical mirrors, and a thermometer in the other, apparently cold is reflected. Now we have to explain this phenomenon according to the hypothesis that there is only one thing—heat, and the absence of that is cold, and that has induced people to look upon the state of matter with regard to heat in this way. It is supposed that all bodies are giving out heat to all other bodies, but that the balance of exchange is in favour of the colder bodies. When I hold my hand by the side of the flame of a candle I am receiving heat, and it is supposed that my hand is giving out heat just as much when I hold it near the flame of a candle as when near a mass of ice, but in the latter case my hand gives out more heat than it receives. The face of the pile may be placed in one focus and the freezing mixture in the other, when the pile is found to give out more heat than it receives, and therefore becomes cold. The pile may be looked upon as the red-hot copper ball, and the freezing mixture as the gun-cotton. It is only by thought of this kind that one can reconcile this apparent radiation of cold with the well-accepted idea that there is no such thing in the abstract.

Attention was lastly directed to two pots containing hot water to begin with, and kept at the same distance for some time over a sheet of hot iron, to prove that the heat radiated from the plate, and was reflected more from a bright metallic surface than a dull, sooty one. A companion experiment was made with two pots filled with the same hot water at the same time. The black one was found to be cooler than the bright one, the bright metallic surface refusing to let the heat pass out, just as it refused to let the heat pass in. And so, if you wish to keep water hot for a long time, as you do in making tea, you get hotter and stronger tea by using a metal teapot instead of a dull or earthenware one—the same nature of surface which allows heat to enter a body freely, allows it to leave the body freely, or good absorbers are also good radiators.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 2nd, 1873.

Rev. **William Gaskell**, M.A., Vice-President, in the Chair.

Mr. **Henry H. Howarth**, F.S.A., was elected an Ordinary Member of the Society.

The following letter from Mr. Henry Bowman, of Brockham Green, Surrey, dated 27th November, 1873, was read:—

Seeing the report of Prof. Reynolds's experiments on the nature of the explosive force of lightning, it occurred to me that the Society might be interested in an account of a remarkable thunderstorm which took place here on Friday, the 7th inst. I was not at home at the time, and did not hear of the storm until my return the following week. The Vicar of this place sent a short notice of the storm to the *Times*, copy of which is enclosed, together with some further particulars which he has kindly jotted down.

"The Rev. Alan Cheales . . . writes to us . . . a remarkable storm burst over the valley between Dorking and Reigate on Nov. 7. . . . In general we have a remarkable immunity from thunderstorms, which draw away along the Downs to the north of us. The storm came up suddenly from the N.W. . . . I have just returned from inspecting an oak tree in Betchworth Park . . . which was completely cleft in two. . . . The tree has been chopped down within about 10 feet of the ground. . . . The girth is about 8 feet."

Nov. 20, 1873.

My dear Sir,—In reply to your enquiries relative to the very remarkable thunderstorm of Nov. 7, mentioned in the *Times* of Nov. 12, I have much pleasure in putting before you such other particulars as I have been able to gather. There was no warning whatever; a black cloud rolled up, a little rain, and then two tremendous flashes. The tree struck was a fine young oak, half covered with ivy, in a row with other oaks, some also having ivy on them. E. Batchelar, painter, at Dorking, 2 miles off, describes a tremendous flash of blue light, and thunder instantly. Rev. G. R. Kensit, walking in fields about 1 mile off, described a ball of blue fire, which seemed to fall on his foot. Martha Rapley, coming home through Betchwork Park with perambulator and two children, was only 300 or 400 yards from the tree; was so stunned and blinded that she saw nothing—perambulator seemed wrapped in flames—she did not know whether the children were dead or not until she got home: neither injured. J. C. Richards, Esq., of Boxhill Farm, had a sheep killed about ½ a mile off; he seemed to think it was killed by the same flash that split the tree: there was only one other flash. The tree, unfortunately, was removed at once by Mr. Hope's woodreeve. I could not see that any part was blackened. Mr. Richards observed to me that no conceivable human force could have so split it. Part of the fibre had been made to writhe round in a most remarkable manner. Huge splinters (3 feet by 3 or 4 ins.) were chopped out, and lay a few feet off. The tree was divided, and hung each side of the fence about 8 or 10 ft. from the ground. The lightning seemed to have run down thence along the outside bark into the ground; but the marks were slight. The tree was still solid below the cleft.—I am yours faithfully, **Alan Cheales.**

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, November 27th, 1873.

Dr. **Lunge**, President, in the Chair.

The following paper was read by Mr. P. A. **Berkley** "*On the Practical Employment of Dynamite*":—

The reason I obtrude the following notes on "dynamite," or Nobel's patent safety powder, or, as the Americans call it, "giant powder," is that many manufacturers and others may not know the value of it, or may, like myself, not even have heard of its properties, until compelled by necessity to seek it out. I will not attempt to give its chemical properties, but simply state the need I had for such an agent, and my experience in its use during some months.

In the early part of the present year we took down one of the blast-furnaces at Jarrow, which had been in operation more than ten years, in order that a larger and more economical furnace might be built in its place. When we commenced to take out the foundations for the new furnace, we found that for several feet below the hearth it was one solid block of iron, about 10 feet diameter, I suppose, the weight of which could not be less than 125 tons. As this block was not in the centre of where the new furnace was intended to be built, and as it might again become fusible, and so injure the new furnace, it was absolutely necessary to have it removed. The two courses open were either to excavate under it, and so bury it, or to break it into pieces that could be removed. The latter course appeared preferable, for the value of the iron broken up so that it could be re-melted was about £3 per ton; consequently I had holes drilled into the iron, about 1½ to 2 inches diameter, and filled with gunpowder, well stemmed, but the discharge had not the least effect. Steel wedges and other methods were tried, but proved of no avail. I then made enquiries as to other explosives. When I heard of dynamite I put myself into communication with Mr. F. H. Edwards, the agent for the North of England, and with him I experimented upon a block of iron, about 2 feet 6 inches across, and 1 foot 6 inches thick, without any hole being bored. Two cartridges (about 4½ ounces) of dynamite were exploded on the top of it, but had no effect; we then exploded about 9 ounces, which broke the block clean in two pieces. I then saw that with holes bored it was possible to break up the whole lump. Four rattle braces were kept continually at work in drilling holes, 1½ inches diameter, at about 3 feet apart. We could not drill the entire depth, so had to break off the top 2 feet, after which we took other 2 feet off, when we had sufficient thickness to form a good hearth. I may state that in some instances the explosion of the dynamite broke off the iron on the outside to the full depth, and the block was cracked through the centre. The whole of the block could thus have been broken up if time had not been more valuable than the iron. Some of the fractures were 4 feet by 3 feet, of the toughest cast-iron I have seen; doubtless it became so by cooling very slowly. The curious may ask, How did this quantity of iron get there? This is easily answered. The hearth of the furnace was laid with fire-brick lumps, 2 feet high, of a wedge form, so that they could not rise, but in process of time these melted out; under these were ordinary fire-bricks, laid in lime. When the fluid iron came upon them, they, being the lighter, were floated up and were melted; so it continued until the iron got through the foundations on to the clay. Some four or five years since I was much troubled with this furnace; we "tapped" it at the usual times, but for days we got no iron out, the charges were put in, and the slag ran as freely as ever, but no iron came (a wag suggested that they had tapped her from "below"). The furnace was allowed to stand open for some time with the blast off, after which it worked as productively as ever.

It may be interesting to many to know what dynamite is, what are its properties, and how it is used. Dynamite is composed of 75 per cent of nitro-glycerine, well mixed with 25 per cent of an infusorial earth, known as "kieselguhr," which is sufficiently absorbent in quality to prevent exudation. It is of a light brown colour, and when in a proper state for use is of a pasty consistence. It should be kept at about 50° or 60° of temperature; when cold it is not so effective. Dynamite explodes at 420° F. I consider dynamite much more safe than gunpowder; when laid open and set fire to, it quietly burns away. Our men were all perfectly new to its use, and never had the slightest accident with it. It always exploded when a lighted match was applied, never without, and it never hung fire. Although I have not tried what concussion dynamite will stand, it has been tested by a case containing 56 lbs. of dynamite being thrown from a height of 130 feet into a quarry, and it did not explode. It explodes in one-twentieth of the time it takes gunpowder, and is three times as powerful. With its rapidity of explosion the downcast force, although not confined, is strangely great, as instanced in the block of iron, 2½ feet by 1¾ feet, being broken in two by about 1 lb. of dynamite, whereas powder, without being confined, would have had no effect. Dynamite in exploding does not scatter the fragments about like gunpowder, unless the hole has been fired two or three times, and become much shattered. For instance, the breaking-up took place between two blast-furnaces, only some 20 feet distance; at the back, about the same distance, were the heating stoves, and close at hand were the water-pipes for supplying the furnace tuyeres and boilers, also the blast main and waste-gas tube, and yet no injury of consequence occurred. Certainly, a few pieces did fly, one piece about 10 lbs. weight, was thrown across the river into Willington Quay, breaking the top of a shop door frame, and rather startling an old couple that were passing at the time; but I can assure you that I was heartily glad when I got through my work, and was thankful that amidst such a dense population no serious damage was done. At first we tried, by putting timbers across the holes chained together, to prevent the pieces flying, but it made matters worse, as the timber was scattered about fearfully. At times, when we used a large charge, say 2 lbs., the concussion was terrific, shaking the whole place. There is no stythe from it like gunpowder, and therefore in that instance it is well adapted for mines where the ventilation is not good. Dynamite must be most valuable for blasting among water, as no damp affects it.

The using of dynamite is very simple; it is supplied from the manufactory in cartridges, about 3 inches long, and about 7-8ths of an inch diameter, weighing between 2 and 3 ounces. A special fuse is made for it, but any ordinary fuse will answer. The end of the fuse is cut clean and square, and inserted into a special cap or detonator; the cap is fastened on to the fuse by a pair of nippers (a little tallow may be put upon the joint to keep any water out of the cap); the cap is then inserted into a small cartridge called the primer; the parchment having been opened to receive it is tied over the fuse to prevent it coming out of the cartridge; the hole that has been drilled is filled with water, and a sufficient number of cartridges put in (I have put in as many as twelve in one hole) and each pushed home by a piece of wood (iron should not be used), so as to fill the hole, and all come close together; on the top is placed the primer cartridge, with the fuse attached, and cut to a sufficient length to let the men get away. The hole being filled with sand, or water, which is better, as water does not in the least injure its action, the fuse is fixed, which communicates with the fulminating powder in the cap, which explodes the dynamite.

Frequently, if the block is large, the first explosion will not break it, but the hole will have been made more than twice the diameter, so that double the quantity of dynamite may be put in the second time, which is pretty sure to do execution.

I need not say that nearly every one seems to dread "nitro-glycerine;" perhaps we have good reason, for the terrible accident that hurried our amiable townsmen out of the world is still fresh in our memories. But this preparation of it seems to me perfectly safe. It has for the last eight years been used very freely on the Continent, where there are some ten or eleven manufactories, one of which, near Hamburg, produces more than 1000 tons annually, and every facility is given, both by the governments and railway companies, for its transportation and use. It is not so in this country, as before using it you must have a special license from the Home Secretary, and the conditions of license are most arbitrary and binding. Many of the railways, among them the North Eastern, absolutely refuse to carry it, and as the only manufactory in Great Britain is at "Ardeer," on the coast, about thirteen miles from Glasgow (The British Dynamite Company), it must either come by sea or by the underground railway. It is not for me to say how I got it. I had a conference with Mr. John Downie, who feels keenly the prohibitions of the Government and railway companies.

Mr. **Berkley** exhibited a nitro-glycerine cartridge and fuse.

Mr. **Pattinson** asked if it was not a fact that there had been a good many accidental explosions of dynamite?

The **President** said, Mr. Berkley had made a remark just now about explosions from dynamite being unknown. It might be that, after it was once manufactured, it became comparatively harmless without being exploded at will. But it was known to him (the President) that one of the manufactories on the Continent, where it is made, had already twice been entirely destroyed by an explosion. On the last occasion it was so entirely destroyed that it was quite impossible to make out in what way the explosion happened, because everybody present at the time of the accident was blown to atoms. It was a personal friend of his own to whom the manufactory belonged, and who, fortunately for himself, was not present at the time of the last accident. Still, although this was a fact, which he knew from personal knowledge, yet it might be that Mr. Berkley was quite correct in this—that when once kieselguhr was impregnated with nitro-glycerine then the explosive properties of the nitro-glycerine were so far subdued that it could be handled in comparative safety. That the gentleman who was in these factories was not an amateur, or one who could be blamed for his own ignorance on account of these explosions, was, he thought, proved by the fact that he was employed by Mr. Nobel to go out to California, and introduce the manufacture of it there, so that he must have been competent in the matter. Perhaps it might interest them to hear that he did not go out until Mr. Nobel had insured his life for £3000. It is perfectly correct, to his own knowledge, what Mr. Berkley states, namely, that dynamite is in quite regular use on the Continent for mining operations, and by different governments for operations of war; and its manufacture and its carriage are not subject to any but reasonable precautions. It seemed as if now the proper medium had been found to make nitro-glycerine available for the purposes to which it was from the very first destined, but which it did not fulfil, on account of the very great danger connected with its handling; but it might be interesting to say that a great many absorbents of nitro-glycerine had been tried, but that they had all failed. The inventor of dynamite, Mr. Nobel, had the monopoly of the special substance which Mr. Berkley mentioned, namely, kieselguhr; and in order to be able to manufacture a similar article, a large number of other bodies had been tried, but none of them had succeeded to anything like the extent of kieselguhr. It is found, at least in large quantities, only in one spot, near Luneburg, in North Germany, but it is found in immense quantities there, and, so far as that was concerned, there was not the slightest difficulty in getting a sufficient supply of it. It is nearly pure silica, and consists of shells of infusoria of past ages. It was a whole geological bed, and so far no other use for it exists; at least the other uses to which it had been put had been given up—for instance, the manufacture of water-glass.

Professor **Marreco** thought the paper a most interesting one, and a valuable addition to their knowledge of nitro-glycerine preparations; but he must say it had not in the least increased his faith in them. He believed that for these purposes gun-cotton was the safest. He had a good deal to do with this when it was attempted to introduce it into this neighbourhood, and he was not very sorry it was not introduced; but he did believe that nitro-glycerine is thoroughly and radically unsafe. They were told it was innocuous; yet they somehow heard of its exploding under some conditions or other which were never ascertained, because, unfortunately, as Dr. Lunge observed, there was very seldom anybody left to tell you anything about it. There was another instance of the dangerous character of the whole class of compounds of this nature, and that was the explosion, probably of nitrate of methyl, which the late Mr. Chapman was destroyed by. Here was the fact, that Mr. Chapman, than whom no man could be more careful, was destroyed by this compound, under circumstances which they knew nothing about. All they could say was that the whole place was blown up. With regard to the stythe from that part of the nitro-glycerine which was not exploded, he did not see why a little silica should make it less stythey; and they knew that the men complained greatly of the stythe in close pits.

The **President** said, that when Mr. Berkley was reading his paper he was thinking himself of the stythe from nitro-glycerine or dynamite, which are quite identical in this respect, and he considered it certainly as bad as that from gunpowder in a confined place, but perhaps not in an open place; and as he understood that experiments had been tried only in open places, it would not be so conspicuous, because there was no smoke from it; but the stythe would be just as bad as from gunpowder, perhaps worse, only there would be no visible smoke. He did not think Professor Marreco's objections to dynamite were quite so valid as he thought them, because practice had a great deal to say in these matters; and although Professor Marreco did not see any physical reason why the admixture of 25 per cent of a porous material should make nitro-glycerine so much less dangerous than it is in the liquid state, yet it was a fact which had been tried not only by a few show experiments before an unscientific audience, but by practice. He did not believe in such things as show experiments himself; but it had been tried by many years practice. He did not think it was requisite to carry such explosive compounds in the same train as passengers. If that were the case, he thought the objection would be perfectly valid, but prohibiting the carriage of such substances altogether, in any sort of trains, was, he thought, going too far; but it was not for him to tell companies what they were to do and what they were not to do.

Mr. **Berkley** had consulted those who had used explosives, and he could not find any other agents which would break up the iron except dynamite. Gunpowder had not the slightest effect upon it; and it was really wonderful with what a small charge it was done. Even the small cartridge, a specimen of which he produced, was tried, and the blast splintered and cracked it in almost every part. To put in an inch and a half after the first discharge would make it a two and a half inch hole. How it deepened it, and where the material went to, it was difficult to tell; but such was the effect. With reference to the explosion at the manufactory which Dr. Lunge had mentioned, it ought to be borne firmly in mind that it was not dynamite which exploded, but glycerine. Of course nitro-glycerine would explode, and dynamite as well, but what he contended for was that dynamite, in the form in which we can now get it, is a safe substance to use. He would also state that in ironstone mines where they had used it, it had not proved of more value than gunpowder. It does not shatter the stone as gunpowder does; and in ironstone mines they were obliged to use gunpowder to shatter the stones, but dynamite throws a great lump off. With reference to what he had said about stythe, he should, perhaps, more correctly have said smoke. There was not the slightest smell that he had experienced from explosions of dynamite. Now, anyone who had exploded gunpowder in mines, as he had done, knew that the stythe for several minutes afterwards was almost unbearable.

GEOLOGISTS' ASSOCIATION.

At the meeting of this Association on the 2nd January, a paper was read by Mr. **Hawkins Johnson**, F.G.S., on "*The Nature and Formation of Flints and Allied Bodies.*"—The object of the paper is to show the nature of several members of a large group of bodies occurring in sedimentary deposits of different ages, and which are generally known as nodules, and described as concretionary. Those specially alluded to are the septeria from the London and Kimmeridge clays, the flints from the chalk, the iron pyrites from the chalk, the phosphatic nodules of the Gault, the clay ironstone nodules of the carboniferous series, and the ironstone from the Woolwich beds.

By the gentle action of solvents, the structure of these bodies is revealed so as to be easily examined by the microscope. They are then found all to agree in possessing a silicified organic structure, which may be described as a network of fibres, or a mass permeated in every direction by anastomosing canals. This structure was subsequently filled in with other material, such as carbonate of lime, silica, bisulphide of iron, phosphate of lime, carbonate of iron, &c., the particular substance thus filled in depending upon the relative abundance of the substances dissolved in the interstitial water of the surrounding matrix.

The singular groups of concentric, siliceous, circular bands seen upon many fossils, and known as orbicular silica, or beekite markings, are also explained. The fossils on which they occur were imbedded in a matrix more porous than themselves, and of irregular constitution, so that the evaporation, to which the consolidation of the dissolved silica in their pores was mainly due, occurred at a number of points on the surface of the fossils, at which points a deposit of silica took place, forming the central tubercles. The cessation of evaporation was followed by a fresh saturation with the solution, to be again evaporated; but as the evaporating points were now plugged up by the previous deposits, the silica last consolidated was deposited around their margins and upon them internally, appearing outwardly as a ring round the tubercle. Alternations of these conditions account for the numerous bands seen in some of the groups.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 1, 1873.

Note Accompanying the Presentation of Poncelet's "Cours de Mechanique Appliquée aux Machines."—M. Resal.

Terrestrial and Solar Waterspouts (Trombes).—M. Faye.—The author follows up his reply to M. Tarry (see vol. xxix., p. 10) by a direct examination of the facts. He quotes a page or two from Dr. Reye's work describing the phenomena. The waterspout is shown to be a sort of machine, an apparatus for transmission of force, and doing enormous work at one of its extremities. Where is the force thus transmitted? Is it below or above? Below, the air is usually calm, and it is in the heart of the calm that waterspouts often appear. It seems doubtful that the force can come from the heart of this calm. In any case it would only be distributed over a wide space; then how could it accumulate at a particular point, and how could this point of concentration travel along in the immobile layer? Further, the only force which may exist in the latent state in an immobile layer is the rising tendency produced by abnormal rise of temperature. It must be a very weak force at each point of the layer, but, if all the forces were united in a small space, their sum might be considerable. To produce this, the elementary forces must be hindered from producing their effect where they are generated. The weight and cohesion of the upper layers must oppose, for some time at least, the ascent of all the fine air-currents which ordinarily arise in a fluid medium to restore the equilibrium. We have here a restrictive condition; still, this state of instability is sometimes produced for some time. It occasions mirage; but a complete calm is necessary for it. If the wind blows, there is a mixture of layers unequally heated; the small ascensional forces do the work *in loco*. Thus we already see that waterspouts would never be able to arise in moving air: but they do; hence we must seek the origin of their force, and its aliment, elsewhere than in the inferior layer. The author next represents the accumulation of hypotheses constituting Dr. Reye's theory of ascending waterspouts in calm air; horizontal convergence of the various parts of the layer to a particular point; a column of air rapidly ascending from an annular orifice at this point; the forces, previously distributed over a large extent of land, engulphed, as it were, in the annular space; the rising column carrying up vapour, which soon condenses; progressive displacement of the cloud along with that of the ideal annular orifice; the latter moving in the direction where the weakest of all the convergent currents comes to it; its movement due to the difference of two velocities diametrically opposed; rise and fall of the currents along with rise and fall of the ring, &c. With regard to waterspouts in agitated air, the theory is dumb, for here there is wanting the essential element of force. What could cause the air of a vast horizontal layer to flow thus violently towards an ideal annular aperture? It is undoubtedly not because a first file of molecules has passed that all the others in a radius of several leagues would be forced to do it also. This conception is at variance with the idea we are led to form of the laws of Nature, which does not expend a large amount of work where it is easy to reach the end by a small expenditure. For, if we consider it, the point here is only to restore the equilibrium (deranged for the moment) of a layer of air. To prop up the hypothesis of ascending waterspouts, it has been necessary to expressly imagine a mechanical process quite inadmissible for the magnitude of the phenomenon; it has then been necessary at each new *trait* to adduce fresh causes not less singular; and all without furnishing an explanation of well-characterised phenomena, such as that of a waterspout progressing against the inferior wind. On the other hand, consider the simple facts. Here is a true machine—on one hand, the force; on the other, the work produced. If we cannot find the force below, *where there is no movement*, we have only to raise our eyes to the mouth of the waterspout; there we find storm-clouds moving with a high velocity, showing that there is force above. The waterspouts are formed above at the expense of these vast currents, which have invaded the upper regions. Not that the currents themselves generate waterspouts; but we know, from the daily example of our watercourses, that differences of velocity in neighbouring sections give rise to gyratory movement. Now this gyratory movement, which may enclose vast spaces, collects, and makes to converge to a centre, those *pre-existent* inequalities of velocity. It sums them up, so to speak, in a vortex, the rapidity of which increases towards the centre, and transmits from layer to layer all this *vis viva*, until it is exhausted below on obstacles. In air, the summation and transport are a thousand times easier than in water, the loss due to friction being small. The waterspout is propagated downwards through the successive layers of the atmosphere, reaching the ground almost without having lost any of its energy. At the moment of contact it acts against the resistance, and produces devastative work, a strict representation of the *vis viva* which was stored up above. If it comes to a valley where its point ceases to touch the ground, the work ceases also, but then the point re-commences to descend, and soon resumes its ravages. These are nearly limited to the circle embraced by the base of the waterspout, but the cold air which escapes, and is re-heated, rebounds on the ground, and rises tumultuously about the waterspout. Thus we see the meteor surrounded at its base by a cloud of ascending dust, and in the sea with a cloud of foam. It is thus that it raises light substances, but it never makes them pass through its funnel (as some have supposed). It matters little to it whether it act in calm or in agitated air; it follows the movement of its funnel, or of the upper current which supplies it. If the inequalities of the current are diminished, the waterspout loses its force; it ceases to reach the ground; it gradually rises, and seems suspended for a time like a horn, ready, however, to re-commence, if the current above experiences resistances or eddies. The author remarks, in conclusion, that the discussion has made marked progress lately, especially in Germany, thanks to Dr. Reye's letter and a recent memoir by M. Zöllner. In Germany, the depth of the spots is now accepted; neither M. Zöllner nor M. Reye places them on the photosphere, but they are supposed embedded in its thickness. This supports the author's theory, and is against that of clouds.

Double Refraction; Directions of Vibratory Movement of Rays Refracted in Uni-Axial Crystals.—Memoir by M. Abria.—(Extract).—The author has found that there is sometimes a great difference between the azimuths of the planes of polarisation of the incident ray, corresponding to the extinction of the ordinary or extraordinary refracted ray, according as the incidence is normal or oblique. He sought to deduce from such differences a verification of Fresnel's theory of double refraction. In fifteen experiments, made with two prisms of spar and of quartz, the difference between calculation and observation varied from a few minutes to 3 degrees.

Observations on M. Faye's Communication.—Gen. Morin.—The author draws attention to the phenomena produced behind obstacles in the rapid stream of a river.

Analytical and Experimental Study of the Interferences of Elliptic Rays,—Memoir by M. Croullebois.—(Extract).—Elliptical polarisation, it is known, forms the transition between rectilinear and circular; for the former of which the conditions of interference have been defined by Arago and Fresnel, and verified by Fizeau and Foucault; for the latter by Fresnel, Babinet, and Billet. The author thus seeks to complete the study to some extent.

Carrier Pigeons which Returned to Paris During the Siege.—M. de Fonvielle.—The value of the service rendered by the seventy-three pigeons which returned during the siege has been exaggerated; only sixteen are thought to have been of use with reference to movements of the armies of defence. Of forty-three balloons, twenty furnished pigeons which returned. The most useful balloon was the "General Uhrich," which took with it thirty-six pigeons, fourteen of which returned. It appears from a study of the two branches of the aërial service that it is too late to organise an art of the kind satisfactorily when under the enemy's fire.

Theorem of Celestial Mechanics.—M. Siacci.

Movement of an Elastic Wire, One Extremity of which is Animated by a Vibratory Movement.—M. Mercadier.—The writer gives an equation which represents this movement, and shows how the consequences of it are identical with the experimental laws previously indicated.

Note on Magnetism.—M. Treve.—The author had formerly called attention to the magnetic movement produced by magnetisation. In the heel of an electromagnet, induction currents were obtained, the direction of which varied with that of the inducing current; this he attributes to the action of a magnetic intermolecular movement exchanged between the poles. Prosecuting the study, he took a long iron bar, one end of which had a strong inducing bobbin, while an induced bobbin could be slid along; and he has examined the conditions in which the magnetic movement is propagated, and observed, *e.g.*, the very rapid decrease of intensity of induced currents generated from the same inducing force, in proportion to the withdrawal of the induced from the inducing bobbin, as also the influence of the section of the bar on the intensity of these currents. What he thinks the most useful result is the ascertaining of a notable retardation of the induced currents (or "*d'arrivee*") or the inducing currents (or "*de depart*"); that is to say, that the magnetic movement is slow relatively to the electric movement. He proposes to try and measure the velocity of propagation of this kind of movement.

Difference of Physiological Action of Induced Currents According to the Nature of the Metallic Wire Forming the Induced Bobbin.—M. Onimus.—The author made exactly similar bobbins of copper, lead, and German silver wire. When the wire of the bobbin is a bad conductor of electricity, the muscular contraction produced is stronger, and the impression on the cutaneous nerves is less vivid than with good conductors, as copper. These effects are more marked the greater the exterior resistance. The current induced in bad conductors has greater tension than that in good, and less quantity. Coils of German silver wire may, in accordance with these facts, be advantageously used in electro-medical apparatus.

Zeitschrift fur Analytische Chemie, von Dr. C. R. Fresenius, Zwölfter Jahrgang, Zweiter Heft, 1873.

Superphosphates Containing Iron and Alumina, and their Analytical Examination.—Dr. Alwin Rümpler.—The author refers to the phosphorite from the Lahn, and to the "going back" or "reduction" of the soluble phosphate in the superphosphates prepared from that mineral. He satisfied himself, as far back as 1869, that the cause of this reduction was oxide of iron, especially in the state of silicate, and soluble alumina mixed with the phosphate. He now concludes that a soluble ferric salt of orthophosphoric acid is formed. This salt is decomposed by heat, a pulverulent basic salt being deposited, which does not re-dissolve on cooling, and is not soluble in free concentrated phosphoric acid. The same salt is also decomposed by the addition of water or of alcohol. The presence of mineral acids does not hinder these decompositions, only a larger amount of the decomposing agent being required to make the separation complete. The decomposition by heat can be hindered by the presence of an excess of acid. Non-volatile organic acids and their salts hinder also the decomposition by water. The precipitate formed on adding water to this soluble ferric phosphate is a pure tribasic phosphate of peroxide of iron. There is also a salt of alumina corresponding to the soluble phosphate of iron, and capable of decomposition under the same circumstances. The alumina in Navassa phosphate has the same effect as the iron in the Lahn phosphorite. The question now presents itself, Does the compound in question occur in ferriferous and aluminiferous superphosphates? Judging from the phenomena, this seems probable, or we must at least admit that such a compound is formed during the analysis, and under a variety of circumstances in the manufacture of superphosphates, by double decomposition of persulphate of iron and acid phosphate of lime. It has been observed that certain lots of superphosphate never dry if too great heat has been developed on mixing the phosphatic mineral with sulphuric acid. If we enquire what superphosphates possess this property, we always find them to be such as are prepared from materials containing lime or alumina. This point is easily explained if we consider that the soluble phosphate of iron is decomposed by heat. Along with basic phosphate, free phosphoric acid is formed, which never dries and does not re-dissolve the basic salt. If we attempt to dry up such a superphosphate by artificial heat, the evil is only increased. The best method is to spread out the superphosphate as soon as it is mixed. Hence, in the analysis of superphosphates, warm water should never be used to extract the soluble phosphoric acid present. The flocculent turbidity which is sometimes obtained on gently heating solutions of superphosphate, depends on the presence of iron. Neutral phosphate of lime is only deposited on prolonged boiling. In the analysis of superphosphates containing iron and alumina, it will be found that the smaller the quantity of water used in extraction, the more phosphoric acid will be dissolved. Lixiviation with small successive quantities of water is therefore the only suitable procedure, as recommended by Fresenius. In working with Lahn and Navassa phosphorite, we always find that, even immediately after the preparation of the superphosphate, the amount of soluble phosphoric acid never agrees with the calculated quantity, but is always smaller, except a large excess of sulphuric acid is present. The phosphoric acid cannot have gone back; the deficiency arises, therefore, from the imperfect method of analysis. Fresenius, Neubauer, and Lücke distinguish three states of phosphoric acid in superphosphates—(1) such as has never been rendered soluble, (2) such as has been "reduced" or has gone back, and (3) soluble. The author adds a fourth—such as has been rendered insoluble during the analysis. The values of these three differ—the soluble is the dearest, the insoluble counts for nothing (not in this country), and the reduced commands in some districts an intermediate price. Fresenius, Neubauer, and Lücke recommend a concentrated solution of citrate of ammonia for dissolving out the reduced phosphate. The author prefers the oxalate. He calls attention to the possibility of finding less energetic salts or organic compounds which may prevent the precipitation of the phosphate of iron, without re-dissolving the reduced phosphate.

Behaviour of Alkaloids with Sugar and Sulphuric Acid.—R. Schneider.—The author examines the reactions of morphia, codeia, aconita, delphinia, chelerythrin and chelidonin. It must be remembered that besides the gall-acids, the protein bodies, and fatty oils give the same reactions.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 16, November 10, 1873.

Reciprocal Behaviour of Ozone and Water.—Em. Schöne.—The author's results are as follows:—1. Ozone does not oxidise water to peroxide of hydrogen. 2. Ozone is absorbed by water in considerable degree, and this at the ordinary temperature of a dwelling-room; the maximum was 0·0189 grm., or 8·81 c.c. of ozone per litre, at a temperature of 18·2° C., and a pressure of 741·5 m.m. 3. In contact with water, ozone suffers no qualitative change. 4. If ozonised oxygen is passed through water, the proportion of ozone is diminished. 5. The disappearance of ozone is far greater than can be accounted for by its absorption in the water, and must therefore be ascribed mainly to a destructive action of the water. 6. In contact with water, ozone is gradually converted into common oxygen; this takes place at ordinary temperatures. 7. This change is attended with expansion. The author does not consider that rain-water can absorb ozone from the air, on account of the presence of nitrogen.

Analysis of Two Minerals from Greenland.—J. V. Janovsky.—The first of these minerals is a soft stone from inner Greenland, apparently belonging to the chlorite group; colour, dark green; streak, white; soft; fuses at the edges before the blowpipe, and gives the reaction of iron. Hydrochloric acid decomposes it imperfectly, even on prolonged boiling. It contains—

Silica	30·32
Iron, protoxide	7·71
Lime	1·28
Magnesia	29·88
Alumina	17·90
Water	12·28
Phosphoric acid	0·11
Fluorine Sulphuric acid	traces
	99·48

The mineral approximates most closely to klinochlor. The second mineral was a rock resembling zircon-syenite from the island Kikkertarsursurok. It consisted of quartz, a kind of hornblende, eudialyte, nephelin, magnetic iron ore, and a triclinic felspar. The hornblende-like mineral is black, with a green translucence at its edges; its powder is dark green. Before the blowpipe it fuses easily to a black bead. Its composition is—

Silica	44·24
Iron, protoxide	29·46
„ peroxide	4·27
Alumina	1·80
Manganese, protoxide	2·21
Lime	8·84
Magnesia	3·11
Potash	1·31
Soda	0·83
Phosphoric acid	2·33
Loss on heating	1·35
	99·75

The mineral is therefore not arfvedsonite.

Synthesis of Uric Acid, and on Iso-Uric Acid.—E. Mulder.—A hypothetical paper, consisting chiefly of structural formulæ. Iso-uric acid was deposited as a heavy powder on boiling together 2 grms. of alloxantin, dissolved in a minimum of boiling water, and 1 grm. of cyan-anamid, likewise dissolved in a minimum of water.

Ketons from Aromatic Hydrocarbons and Acid Chlorides.—S. Grucarevic and V. Merz.—The authors have examined—α- and β-naphthyl-phenyl-keton; α-dinaphthyl-keton; β-dinaphthyl-keton; diphenyl-keton; tolyl-phenyl-keton; cymyl-phenyl-keton; benzoate of benzoyl-phenol.

Splitting-Up of Certain Ketons by means of Soda-Lime.—S. Grucarevic and V. Merz.—α-naphthyl-phenyl-keton yielded naphthalin and benzoic acid; β-naphthyl-phenyl-keton gave the same products; α-dinaphthyl-keton yielded naphthalin and α- and β-naphthoic acid. Both the modifications of β-dinaphthyl-keton gave rise to naphthalin and β-naphthoic acid.

Gazzetta Chimica Italiana, Anno iii., Fascicolo x., 1873.

Researches on Chloral.—E. Paterno and A. Oglialoro.—The authors have examined the action of sulphuretted hydrogen upon chloral, as also that of dehydrating agents upon the sulphuretted derivative, and that of the pentasulphide of phosphorus upon chloral.

Filtration not a Trustworthy Means for Purifying Drinking-Water Contaminated with Choleraic Poison.—Dr. Dario Gibertini (of Parma).—The author combats the view that the germs of zymotic disease, especially cholera, can be removed from water by filtration. His microscopic observations have convinced him that filters do not remove certain low organisms from water. (This is a subject deserving very serious attention. If Dr. Gibertini's views be correct, irrigation and "intermittent downward filtration" must be powerless to deal with sewage containing the germs of disease, and germ-destroyers, such as carbolic and cresylic acids, are imperatively required in the treatment of sewage).

Researches on Cymen.—E. Paterno.—A preliminary notice.

Observations on Cymen.—Dr. Icilio Guareschi.

Determination of the Specific Gravity of Cymens of Various Origin.—G. Pisati and E. Paterno.—A lengthy paper not suited for abstraction.

Crystallisation of Sulphur in Forms Belonging to the Trimetric System.—Prof. O. Silvestri.—Goniometric measurements of the crystals in question, with determinations of their specific gravity, solubility in bisulphide of carbon, melting-point, and point of re-solidification.

Revue Scientifique de la France et de l'Etranger, No. 21, November 22, 1873.

A View of Certain Chemical Manufactures.—M. Riche.—An account of the present state of the soda and of the superphosphate manufacture.

The Diamond Diggings of South Africa.—Desdemaines Hugon.—The author calls attention to the peculiar climate of the diamond district, and especially to the violent and continued electric action for which it is distinguished. He maintains that the air is always strongly charged with electricity where diamonds abound, and appears to suggest that this circumstance may throw some light upon their formation.

Experiments with Coignet's Manure for Beet-Root.—M. Dehérain.—Coignet's manure "A" was tried against "phospho-guano" (make and composition not stated), and against a mixture of the latter and of guano. All three were applied in equal quantity—600 kilos. per hectare. Coignet's manure appears to have given the greatest weight of roots, with the highest percentage of sugar, and with the smallest outlay. It gave also superior results to a mixture of sulphate of ammmonia and superphosphate. Coignet's manure contains 6 to 7 per cent of nitrogen, 30 per cent of roasted bone-phosphate, and 50 per cent of organic (animal) matter, all reduced to a fine and easily-assimilable state.

MISCELLANEOUS.

Society of Arts.—The following papers will be read before this Society during the present session :—*Ordinary Meetings.*—"On Museums for Technical Instruction in the Industrial Arts and Manufactures of the United Kingdom, and the Appropriation of the Surplus of the Inventors' Fee Fund for that purpose ;" "On German Music, with especial reference to the works of Richard Wagner ;" "Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America ;" "On Eastern Art, and its influence on European Taste ;" "On Type-Printing Machinery, with suggestions thereon ;" "On Thrift as the Outdoor Relief Test ;" "On the Channel Tunnel ;" "On Bells and Modern Improvements for Chiming and Carillons." *Indian Section.*—"On Indian Teas, and the desirableness of Increasing the Use of them in the Home Market ;" "On Indian Art ;" "On our Relations with the Hill Aborigines of Northern India." *Chemical Section.*—"On the production of Anthracen and Alizarin from Pitch ;" "On the Manufacture of Chlorine ;" "On the Utilisation of the Waste Products of Gas Manufacture ;" "On some recent Improvements in the Production of Carbonate of Soda ;" "On Sugar Refining, with special reference to Fingel's Sugar Crystals." In the *African Section* the arrangements are not yet complete. Further particulars will be duly announced in the *Journal* of the Society.

The Gas Supply of the Metropolis.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation and the Metropolitan Board of Works the results of the testings of the gas supplied by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the months of October, November, and December last ; from which it appears that the average illuminating power of the Chartered gas has been 17·34 candles at Beckton, 16·9 candles at Cannon Street, and 17·08 candles at Friendly Place, Mile End ; that of the Imperial Company has been 17·10 candles at Carlyle Square, 16·22 candles at Camden Street, and 15·9 candles at Graham Road ; while that of the South Metropolitan Company has been 16·34 candles. The Cannel gas of the Chartered Company has averaged 21·37 candles at Millbank, and 21·48 candles at Ladbroke Grove. As regards purity, Dr. Letheby reports that, except on two occasions at Ladbroke Grove, the gas at all the testing places has been constantly free from sulphuretted hydrogen ; and that although the amount of sulphur in other forms than this has fluctuated to a rather large extent, yet it has rarely been above the prescribed quantity. In the common gas at Beckton it has averaged 12·73 grains per 100 cubic feet, at Cannon Street 13·41 grains, at Friendly Place 13·02 grains, at Carlyle Square 19·55 grains, at Graham Road 22·94 grains, at Camden Street 20·33 grains, and at Hill Street, Peckham, 25·55 grains. In the Cannel gas it was 21·4 grains at Millbank, and 20·4 at Ladbroke Grove. On seven occasions it exceeded the prescribed quantity, viz., once at Bow, once at Carlyle Square, and five times at Graham Road. On six of these occasions the Imperial Company appealed to the Chief Gas Examiner, in accordance with the provisions of the Act of Parliament, and on enquiry it was ascertained that the excess was due to unavoidable causes, arising out of the large demand for gas during the foggy weather of December last. Ammonia has not been present in undue proportion at any of the testing places but one—namely, that at Ladbroke Grove, where the amount for a considerable number of nights was excessive, thereby rendering the Chartered Company liable, under the 74th Section of the Metropolis Gas Act, 1868, to a penalty of £50 for each night of such default.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in treating explosive compounds to impart safety thereto for blasting and other purposes. Edward Augustus Leonard Roberts, Titusville, Pennsylvania, U.S., at present of 34, Southampton Buildings, Middlesex. March 14, 1873.—No. 926. This invention has for its object improved means of rendering fulminating powders and all fulminates, that are dangerous to handle in a dry state, comparatively safe and useful for blasting and other purposes, by mixing them and using them mixed or combined with water or some other suitable fluid or materials, such as hygroscopic salts, in such proportions as shall render them non-explosive by ordinary agitation, friction, or by a blow or concussion, but yet sufficiently explosive to be capable of being fired by any detonating or fulminating compound, or by some of the same material in a dry state. Explosive compounds treated in accordance with this invention may be packed or enclosed in air-tight envelopes of any suitable shape and material or construction so as to preserve them unchanged. The mixing of explosive compounds with fluids in this manner renders them more dense, thus allowing a greater amount to be held in a given space.

Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, 123, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, 34, Rue du Progrès, Schaerbeck, Brussels). March 14, 1873.—No. 938. In order to produce the carbonates of baryta and strontia according to this process, I take alkaline earthy chlorides, not only because they are very soluble and that sulphates of baryta and strontia are obtained from them with facility and economy, but also that by means of this proces I obtain free hydrochloric acid at the same time that the carbonates of the alkaline earths are produced.

Improvements in the treatment of the liquors used in scouring or cleaning wool. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, 123, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, 34, Rue du Progrès, Schaerbeck, Brussels). March 14, 1873.—No. 939. The object of this invention is—First, to extract the potash in a state of carbonate, which is its most valuable condition, by a process which is at once economical and expeditious ; and, secondly, to completely extract the greasy matters which separate from the washing-liquors.

Improvements in the production of colours for dyeing, printing, and staining. Newton Athow, Pisskynaston, Denbigh. March 20, 1873.—No. 1043. My invention consists principally in utilising the waste or by-product obtained in the purification of crude carbolic acid derived from coal-tar for the purpose of producing colours suitable for dyeing, printing, and staining.

Improvements in the manufacture of glucose or grape sugar from rice and other grain, and in apparatus employed therein. Edwin Egerton Pearse, 7, Oberstein Road, New Wandsworth, Surrey. March 20, 1873.—No. 1044. The invention relates to converting rice and other grain into glucose or grape sugar by feeding such grain through a sealed feeder under steam pressure direct into a saccharifier provided with a revolving hollow shaft and arms partly perforated to admit the steam. Using hydraulic pressure in cleansing and filtering the saccharine solution after conversion, whereby a great saving is effected in the expense of the production of such sugar.

MEETINGS FOR THE WEEK.

Monday, Jan. 19.—Medical, 8.
Tuesday, 20.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."
— Civil Engineers, 8.
— Zoological, 8½.
— Anthropological 8. (Anniversary.)
Wednesday, 21.—London Institution, 7.
— Meteorological, 7. (Anniversary.)
— Society of Arts, 8
— Geological, 8.
Thursday, 22.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8½.
— Royal Society Club, 6.
Friday, 23.—Royal Institution. Weekly Evening Meeting, 8.
— Royal Institution, 9. Prof. Sylvester, M.A., F.R.S., "On Recent Discoveries in Mechanical Conversion of Motion."
Saturday, 24.—Royal Institution, 3. Prof G. Croom Robertson, "On Kant's Critical Philosophy."

Theoretical and Practical Chemistry.—Mr. SIDNEY W. RICH, Analytical and Consulting Chemist, undertakes all kinds of Analyses, including the Analysis of Water, of articles of Food and Drink, and of Commercial Articles.

Mr. RICH also undertakes Investigations relating to Patents, Manufactures, &c. Gentlemen who wish to carry out Investigations personally may have a separate room if privacy be needed.

PRACTICAL CLASSES commence in October, January, and March, but laboratory pupils who work independently may enter at any time.

Further Particulars may be obtained at the Laboratory, 14, CHENIES STREET, TOTTENHAM COURT ROAD, LONDON, W.C.

THE CHEMICAL NEWS.

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RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 30).

The Weights.

A set of weights as ordinarily supplied by even the best instrument-makers is never absolutely exact; however carefully they may be adjusted, the pieces of metal which respectively represent 1000 grs., 100 grs., 10 grs., &c., are only more or less approximations to the true weights. In most chemical analyses, the error arising from such inaccuracies in the weights used is so small, in comparison to errors of manipulation or to imperfections inherent in the chemical processes adopted, that it may generally be disregarded; but when the chemist has for his object the determination of an atomic weight, or is engaged in other researches demanding the highest refinement of accuracy which chemistry and physics can supply, then he is bound to neglect no correction which will increase the precision of the results. That chemists, whose well-trained reasoning powers allow them to take for granted nothing which is not capable of experimental verification, and who insist upon the utmost attainable precision in their balances, should, as a rule, neglect the probable errors which the inaccuracies of their weights may introduce, is somewhat inconsistent. But in considering these eliminations in my memoir, I must disclaim any originality in the process, the description of the method I employed being intended solely to place others on the same footing as myself in their judgment of the possible inaccuracies of my investigations and their effect on the result.

Professor W. H. Miller, of Cambridge, in his valuable researches on the determination of the standard pound (*Philosophical Transactions* for 1856, pp. 811, 827, 937), has given full directions for attaining a similar object. These, however, will not exactly apply to the systems of weights used by chemists; for, of the three cases described by him the former two concern a peculiar system of weights, and in the third, two sets of weights (one for the Exchequer, the other for the Royal Mint) were compared at the same time. To this paper, as well as to the learned author himself, I am indebted for a valuable store of information on the subject of weights and weighings.

The weights employed were of platinum, made expressly for these investigations by Messrs. Johnson and Matthey. The platinum was quite pure; it was fused, cast, and then well hammered. The weights were adjusted by myself during May, June, July, and August, 1864: they were first roughly adjusted, and then the specific gravity of each weight was taken. The weights were heated to redness in a bath of magnesia previous to ascertaining their specific gravity. The density of the larger weights was ascertained to the second place of decimals, and that of the smaller ones to the first place. The record of the final adjustment of these weights will be sufficient to show the method I adopted.

In taking the specific gravity of the weights, the distilled water was contained in a glass beaker of about 230 cubic inches capacity. Each weight was suspended by a fine platinum wire to be attached to the pan of the balance. With this wire affixed the weight was introduced into a small glass vessel filled with water, and heated over a spirit-lamp to the boiling-point. When all the air-bubbles had been expelled by this process, the small jar containing the weight was lowered into the water in the beaker, the weight, on removing the small jar, being perfectly free from any adhering bubbles of air. After the temperature had sunk to the proper point, the specific gravity was taken.

The 1000-grain weight was selected as the standard: for in nearly every process in which weights are used in chemistry, the object is not to ascertain the *absolute* weight of a substance in terms of a grain or gramme, but to determine its *relative* weight in comparison with that which it possessed at some other time before it was submitted to certain analytical or synthetical operations. If the weighings are performed with the same weights, it does not at all matter whether the weights are absolutely of the same value which they profess to be; but it is very important that they should bear a known proportion to each other. This must be understood as referring only to ordinary chemical research in synthesis or analysis. In many physical investigations it is of great importance that the 1000-grain weight should really represent 1000 normal grains, or that its deviation from that value should be accurately determined; but I confess I do not know where a standard weight suitable for such a comparison is to be met with. The weights at first tried were far from accurate among themselves. I accordingly ascertained their errors by the method described below, and then adjusted them myself according to the corrections thus found necessary. The residual errors in the weights were then finally taken in the following manner:—

The balance being brought into equilibrium and the temperature and barometrical pressure carefully noted, the 1000-grain weight was placed in the left pan, and in the right the 600, the 300, and the 100-grain weights. It was now found that, to bring the balance back to equilibrium, a slight additional weight had to be placed on the right side to supplement the three weights already in that pan. This was noted. The weights were then removed to the opposite sides, the 1000 grains being on the right and the three smaller weights on the left. It was now found that a small weight had to be subtracted from the side carrying the three weights in order to produce equilibrium. The weights were removed and interchanged in this manner ten times, so as to eliminate, as far as possible, the errors arising from observation, or the unequal expansion by heat of the arms of the balance; and by applying the method of least squares to the results obtained, the following equation was arrived at:—

$$(1000) = (600) + (300) + (100) \quad + \; 0{\cdot}01000 \; . \; . \; . \; a,$$

the figures within parentheses representing the nominal value of the actual pieces of platinum stamped 1000, 600, 100 grains, &c.

In a similar manner the values of the remaining weights were ascertained; thus,—

$(600) = (300) + (200) + (100) \quad + \; 0{\cdot}00777 \; . \; . \; . \; b$

$(300) = (200) + (100) \quad + \; 0{\cdot}00991 \; . \; . \; . \; c$

$(200) = (100) + (60) + (30) + (10) \quad + \; 0{\cdot}01577 \; . \; . \; . \; d$

$(100) = (60) + (30) + (10) \quad \pm \; 0{\cdot}00030 \; . \; . \; . \; e$

$(60) = (30) + (20) + (10) \quad - \; 0{\cdot}00522 \; . \; . \; . \; f$

$(30) = (20) + (10) \quad + \; 0{\cdot}00154 \; . \; . \; . \; g$

$(20) = (10) + (6) + (3) + (1) \quad + \; 0{\cdot}00355 \; . \; . \; . \; h$

$(10) = (6) + (3) + (1) \quad + \; 0{\cdot}00152 \; . \; . \; . \; i$

$(6) = (3) + (2) + (1) \quad - \; 0{\cdot}00102 \; . \; . \; . \; j$

$(3) = (2) + (1) \quad + \; 0{\cdot}00165 \; . \; . \; . \; k$

$(2) = (1) + ({\cdot}6) + ({\cdot}3) + ({\cdot}1) \quad - \; 0{\cdot}00312 \; . \; . \; . \; l$

$(1) = ({\cdot}6) + ({\cdot}3) + ({\cdot}1) \quad - \; 0{\cdot}00303 \; . \; . \; . \; m$

$({\cdot}6) = ({\cdot}3) + ({\cdot}2) + ({\cdot}1) \quad - \; 0{\cdot}00260 \; . \; . \; . \; n$

$({\cdot}3) = ({\cdot}2) + ({\cdot}1) \quad + \; 0{\cdot}00225 \; . \; . \; . \; o$

$({\cdot}2) = ({\cdot}1) + ({\cdot}06) + ({\cdot}03) + ({\cdot}01) \quad - \; 0{\cdot}00100 \; . \; . \; . \; p$

$({\cdot}1) = ({\cdot}06) + ({\cdot}03) + ({\cdot}01) \quad - \; 0{\cdot}00812 \; . \; . \; . \; q$

$({\cdot}06) = ({\cdot}03) + ({\cdot}02) + ({\cdot}01) \quad - \; 0{\cdot}00607 \; . \; . \; . \; r$

$({\cdot}03) = ({\cdot}02) + ({\cdot}01) \quad - \; 0{\cdot}00612 \; . \; . \; . \; s$

$({\cdot}02) = ({\cdot}01) + ({\cdot}01r')^{*} \quad - \; 0{\cdot}00118r' \; . \; . \; . \; t$

$({\cdot}01) = ({\cdot}01r'') \quad + \; 0{\cdot}00413r' \; . \; . \; . \; u$

$({\cdot}01) = ({\cdot}01r') \quad + \; 0{\cdot}00410r'' \; . \; . \; . \; v$

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* A Paper read before the Royal Society June 20, 1872.

* r′, r″ represent riders, two of which were [illegible]

We have now the data for ascertaining the absolute values of the weights in terms of the (1000) weight taken as standard. Adding the equations *a* and *b* gives—

$(1000) = 2(300) + 2(100) + 0{\cdot}01777.$

Multiplying equation *c* by 2 gives—

$2(300) = 2(200) + 2(100) + 0{\cdot}01982.$

Subtracting *c* from *d* gives—

$(200) = 2(100) + 0{\cdot}01607.$

Now by $(a+b) + 2c + 3(d-c)$ we get—

$(1000) = 10(100) + 0{\cdot}01777 + 0{\cdot}01982 + 0{\cdot}04827;$

$\therefore (1000) = 10(100) + 0{\cdot}08580;$

$\therefore \frac{(1000)}{10} = (100) + 0{\cdot}008580;$

$\therefore (100) = 100 - 0{\cdot}008580;$

$\therefore (100) = 99{\cdot}991420$ grains. . . . A.[*]

Substituting this value for the (100) weight, we get from equation *e*,—

$99{\cdot}991420 = (60) + (30) + (10) - 0{\cdot}00030;$

$\therefore (60) + (30) + (10) = 99{\cdot}991720.$ . . B.

From equation *d* we therefore get—

$(200) = 99{\cdot}991420 + 99{\cdot}991720 + 0{\cdot}01577;$

$\therefore (200) = 199{\cdot}998910.$ . . . . . C.

From equation *c* we get—

$(300) = 199{\cdot}998910 + 99{\cdot}991420 + 0{\cdot}00991;$

$\therefore (300) = 300{\cdot}000240.$ . . . . . D.

From equation *b* we get—

$(600) = 300{\cdot}000240 + 199{\cdot}998910 + 99{\cdot}991420 + 0{\cdot}00777;$

$\therefore (600) = 599{\cdot}998340.$ . . . . . E.

Again, adding *e* and *f*,—

$(100) = 2(30) + (20) + 2(10) - 0{\cdot}00552;$

$\therefore$ from A,—

$99{\cdot}991420 = 2(30) + (20) + 2(10) - 0{\cdot}00552.$

Multiplying *g* by 2,—

$2(30) = 2(20) + 2(10) + 0{\cdot}00308.$

Subtracting *i* from *h*,—

$(20) = 2(10) + 0{\cdot}00303.$

By adding *e*, *f*, twice *g*, and thrice the last equation, we get—

$99{\cdot}991420 = 10(10) + 0{\cdot}000665;$

$\therefore (10) = 9{\cdot}998477.$ . . . . F.

From equation *i* we get—

$9{\cdot}998477 = (6) + (3) + (1) + 0{\cdot}00052;$

$\therefore (6) + (3) + (1) = 9{\cdot}997957.$ . . . G.

Substituting these values in *h* we get—

$(20) = 9{\cdot}998477 + 9{\cdot}997957 + 0{\cdot}00355;$

$\therefore (20) = 19{\cdot}999984.$ . . . . H.

From *g* we get—

$(30) = 19{\cdot}999984 + 9{\cdot}998477 + 0{\cdot}00154;$

$\therefore (30) = 29{\cdot}999991.$ . . . . I.

From *f* we get—

$(60) = 29{\cdot}999991 + 19{\cdot}999984 + 9{\cdot}998477 - 0{\cdot}00522;$

$\therefore (60) = 59{\cdot}993232.$ . . . . J.

Again, adding *i* and *j*,—

$(10) = 2(3) + (2) + 2(1) - 0{\cdot}00056.$

Multiplying *k* by 2,—

$2(3) = 2(2) + 2(1) + 0{\cdot}00330.$

Subtracting *m* from *l*,—

$(2) = 2(1) + 0{\cdot}00196.$

Then $(i+j) + 2k + 3(l-m)$ gives—

$(10) = 10(1) + 0{\cdot}00868;$

$\therefore 9{\cdot}998477 = (10)1 + 0{\cdot}00868;$

$\therefore 0{\cdot}9998477 = (1) + 0{\cdot}000868;$

$\therefore (1) = 0{\cdot}9989797.$ . . . . K.

From equation *m* we have—

$0{\cdot}9989797 = ({\cdot}6) + ({\cdot}3) + ({\cdot}1) - 0{\cdot}00508;$

$\therefore ({\cdot}6) + ({\cdot}3) + ({\cdot}1) = 1{\cdot}0040597.$. L.

From *l*,—

$(2) = 0{\cdot}9989797 + 1{\cdot}0040597 - 0{\cdot}00312;$

$\therefore (2) = 1{\cdot}9998394.$ . . . . . . M.

From *k*,—

$(3) = 1{\cdot}9998394 + 0{\cdot}9989797 + 0{\cdot}00165;$

$\therefore (3) = 3{\cdot}0004691.$ . . . . N.

From *j*,—

$(6) = 3{\cdot}0004691 + 1{\cdot}9998394 + 0{\cdot}9989797 - 0{\cdot}00102;$

$\therefore (6) = 5{\cdot}9982682.$ . . . . . . O.

Again, adding *m* and *n*,—

$(1) = 2({\cdot}3) + ({\cdot}2) + 2({\cdot}1) - 0{\cdot}00768.$

Multiplying *o* by 2 we get—

$2({\cdot}3) = 2({\cdot}2) + 2({\cdot}1) + 0{\cdot}00450.$

Subtracting *q* from *p*,—

$({\cdot}2) = 2({\cdot}1) + 0{\cdot}00702.$

Then $(m+n) + 2o + 3(p-q)$ gives—

$(1) = 10({\cdot}1) + 0{\cdot}01788;$

$\therefore 0{\cdot}9989797 = 10({\cdot}1) + 0{\cdot}01788;$

$\therefore 0{\cdot}09989797 = ({\cdot}1) + 0{\cdot}001788;$

$\therefore ({\cdot}1) = 0{\cdot}09810997.$ . . . . . . P.

From *q* we get—

$0{\cdot}09810997 = ({\cdot}06) + ({\cdot}03) + ({\cdot}01) - 0{\cdot}00802;$

$\therefore ({\cdot}06) + ({\cdot}03) + ({\cdot}01) = 0{\cdot}10612997.$ Q.

From *p*,—

$({\cdot}2) = 0{\cdot}09810997 + 0{\cdot}10612997 - 0{\cdot}00100;$

$\therefore ({\cdot}2) = 0{\cdot}20323994.$ . . . . . . R.

From *o*,—

$({\cdot}3) = 0{\cdot}20323994 + 0{\cdot}09810997 + 0{\cdot}00225;$

$\therefore ({\cdot}3) = 0{\cdot}30359991.$ . . . . . . S.

From *n* we get—

$({\cdot}6) = 0{\cdot}30359991 + 0{\cdot}20323994 + 0{\cdot}09810997 - 0{\cdot}00260;$

$\therefore ({\cdot}6) = 0{\cdot}60234982.$ . . . . . . T.

Again, adding *q* and *r*,—

$({\cdot}1) = 2({\cdot}03) + (0{\cdot}2) + 2({\cdot}01) - 0{\cdot}01409.$

Multiplying *s* by 2 we get—

$2({\cdot}03) = 2({\cdot}02) + 2({\cdot}01) - 0{\cdot}01284.$

Subtracting *u* from *t*,—

$({\cdot}2) = 2({\cdot}01) - 0{\cdot}00531.$

Then $(q+r) + 2s + 3(t-u)$ gives—

$({\cdot}1) = 10({\cdot}01) - 0{\cdot}04286,$

$\therefore 0{\cdot}09810997 = 10({\cdot}01) - 0{\cdot}04286,$

$\therefore 0{\cdot}009810997 = ({\cdot}01) - 0{\cdot}004286,$

$\therefore ({\cdot}01) = 0{\cdot}014096997$ . . . . . U.

From *u* we get—

$0{\cdot}014096997 = ({\cdot}01r'') + 0{\cdot}00413,$

$\therefore ({\cdot}01r'') = 0{\cdot}009666997$ . . . . V.

From *t* we get—

$({\cdot}02) = 0{\cdot}014096997 + 0{\cdot}009666997 - 0{\cdot}00118,$

$\therefore ({\cdot}02) = 0{\cdot}022883994$ . . . . . W.

From *s* we get—

$({\cdot}03) = 0{\cdot}022883994 + 0{\cdot}014096997 - 0{\cdot}00642,$

$\therefore ({\cdot}03) = 0{\cdot}030560991$ . . . . . X.

From *r* we get—

$({\cdot}06) = 0{\cdot}030560991 + 0{\cdot}22883994 + 0{\cdot}014096997 - 0{\cdot}00607,$

$\therefore ({\cdot}06) = 0{\cdot}061471982.$ . . . . . Y.

From *v* we get—

$0{\cdot}014096997 = ({\cdot}01r') + 0{\cdot}00410,$

$\therefore ({\cdot}01r') = 0{\cdot}009996997$ . . . . . Z.

The value of the weights thus given was, however, their weight in *air* of the ordinary pressure; it became therefore necessary to ascertain their value in a vacuum. All bodies displace a bulk of air equal to their own volume, and the weight of this air is of course greater as their specific gravity diminishes. In delicate investigations this loss of weight is important. The reduction of the platinum weights to their true value *in vacuo* I calculated by the following formula:—

Let W = weight in air,

w = ,, water,

a = specific gravity of air as compared with water;

then—

x, or weight *in vacuo*, $= \frac{W - aw}{1 - a}$, where—

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[*] Although these decimals are carried to the sixth place, the balance would not indicate beyond the fourth place. By taking the mean of ten interchanged weighings, I could obtain a fifth place. The calculated values of the weights were carried to a sixth decimal, in order to avoid inaccuracy in the fourth and fifth places when several values were summed.

$$a = 0·001225, \text{ and}$$
$$1 - a = 0·998775.$$

The following table shows the final results of these adjustments:—

Nominal Value of Weights.	True Value in Air at 30 in.* 62° F.	Weight of Air Displaced.	Volume in Water of Maximum Density.
Grs.	Grs.	Grs.	Grs.
1000·00	1000·000000	0·058271	47·5100
600·00	599·998340	0·035533	28·9700
300·00	300·000240	0·017501	14·2700
200·00	199·998910	0·011664	9·5100
100·00	99·991420	0·005887	4·8000
60·00	59·993232	0·003483	2·8400
30·00	29·999991	0·001668	1·3600
20·00	19·999984	0·001104	0·9000
10·00	9·998477	0·000490	0·4000
6·00	5·998268	0·000355	0·2900
3·00	3·000469	0·000171	0·1400
2·00	1·999839	0·000113	0·1000
1·00	0·998980	0·000055	0·0400
0·60	0·602350	0·000035	0·0300
0·30	0·303600	0·000017	0·0200
0·20	0·203240	0·000011	0·0100
0·10	0·098110	0·000005	0·0040
0·06	0·061472	0·000003	0·0030
0·03	0·030561	0·000002	0·0020
0·02	0·022884	0·000001	0·0010
0·01	0·014097	0·000001	0·0004
0·01′	0·009997	0·000001	0·0004
0·01″	0·009967	0·000001	0·0004

The value of each weight in air, *plus* the weight of air displaced, is, of course, the weight *in vacuo*.

Having ascertained their true value, the weights were carefully preserved; and as, being of platinum, there was no accumulation of tarnish on their surface, and as they were lifted with ivory-tipped forceps to prevent wear, they have showed up to the present time, whenever compared, absolutely no alteration.

(To be continued.)

ON CYMENE AS A CONSTITUENT OF, AND DERIVATIVE FROM, OIL OF TURPENTINE.

By C. R. A. WRIGHT, D.Sc.

On Feb. 6, 1873, the writer read before the London Chemical Society a paper (CHEMICAL NEWS, vol. xxvii., p. 82; *Journ. Chem. Soc.*, [2], xi., 549) wherein it was shown that there are reasons for supposing that the small quantities of terephthalic acid obtained by the oxidation of certain terpenes are really derived, not from the terpene itself, but from cyamene simultaneously present; and it was moreover stated that cymene had been actually isolated from two such terpenes (viz. myristicene from nutmeg oil and terebenthenes from oil of turpentine) by a process suggested to the writer by Dr. Hugo Müller, viz., "treating the mixture with sulphuric acid so as to polymerise the terpene present, and then diluting with water, and distilling in a current of steam."

Shortly after (April 3, 1873), the writer read a second paper describing the properties of the cymene thus obtained, and contrasting them with those of cymene from other sources (CHEMICAL NEWS, vol. xxvii., p. 186; *Journ. Chem. Soc.* [2], xi., 686).

On Feb. 21, 1873, M. Ribau communicated to the Paris Chemical Society the results of his experiments on the action of sulphuric acid on terebenthene (*Bul. Soc. Chem. Paris*, xix., 242), and on July 4, 1873, he also read another paper on the same subject (*Ibid.*, xx., 97 and 100), the result arrived at being that cymene is found from the terpene by the reaction $C_{10}H_{16} + H_2SO_4 = 2H_2O + SO_2 + C_{10}H_{14}$. In a postscript to the second of the above mentioned papers, written before the appearance of M. Ribau's second communication, the writer suggested that the cymene obtained by M. Ribau was not formed thus, but was that precontained as such, the main reason given being that by cautiously acting on oil of turpentine with sulphuric acid, "the writer had succeeded in isolating cymene from oil of turpentine, without the evolution of more than inconsiderable quantities of sulphurous acid." The method employed was as follows:—Oil of turpentine freed from oxidised substances by distillation over sodium was very gradually mixed with about its own weight of sulphuric acid, the mixture being carefully cooled; after a few minutes the whole was poured into a large bulk of water, the oily layer decanted and distilled with water, and the oily layer of distillate treated repeatedly in the same way. Only once or twice was a very faint odour of sulphurous acid observed; and, as about 3 per cent of nearly pure cymene was ultimately obtained (irrespective of losses and waste in distillation), it was inferred that this was precontained as such.

It being in no way improbable that some specimens of oil of turpentine might contain more cymene than others, the pre-existence of M. Ribau's cymene thus appeared exceedingly probable, even though the amount obtained by this chemist was considerably above 3 per cent.

Between August 20, and September 1, 1873, Herr Orlewski read before the Meeting of Russian Naturalists, at Kasan, a paper, in which he states (as reported by Richter, *Ber. Deut. Chem. Ges*, vi., 1257), that considerable quantities of cymene are produced by the action of sulphuric acid on turpentine oil in the ordinary process for preparing terebene; and that terebene itself is altered by this reagent, cymene being formed, sulphurous acid being simultaneously generated. At the same time Herr Orlewski stated, that by long continued fractional distillation of an old yellowish sample of turpentine oil, he succeeded in isolating a small percentage of cymene (10 grammes from 1½ litres), and ascribed the presence of this substance to the action of atmospheric oxygen on the original oil, whereby hydrogen is removed from the terpene.

As regards this explanation, the writer has shown (*loc. cit.*) that by the action of oxidising agents, certain terpenes undergo the reaction, $2C_{10}H_{16} + O_2 = 2C_{10}H_{16}O$, the resulting bodies presenting great similarity to certain isomerides of camphor which readily break up by treatment with dehydrating agents into cymene and water, $C_{10}H_{16}O = H_2O + C_{10}H_{16}$. M. Ribau has very recently published in the *Bulletin* of the Paris Chemical Society (January 5, 1874, pp. 3, 4) two notes, the one a reclamation for priority over Herr Orlewski, the other a discussion of the reasons assigned by the writer for supposing that the cymene obtained by M. Ribau was precontained as such.

As regards the first question, a comparison of the above dates will show that, whilst M. Ribau undoubtedly preceded Herr Orlewski in this matter by several months, the results of the writer were made public in London, more than a fortnight before those of M. Ribau were first brought before the notice of Parisian chemists; it is therefore evident that, whilst the experiments of M. Ribau and the writer must have been carried on almost simultaneously, the actual claim to priority rests with England rather than with France or Russia.

As regards the second point, the writer has great pleasure in confirming the exactitude of M. Ribau's results; whilst he has no doubt from his own results (and those of Herr Orlewski) that cymene is actually precontained in, at any rate, some specimens of oil of turpentine; and in other terpenes he has yet found that when the action of the sulphuric acid is prolonged for some hours at the ordinary temperature (and especially if the mixtures be made quickly so as to heat rapidly), sulphurous acid is copiously given off, and *a much larger quantity of cymene is obtainable than can be if all possible care and precautions are taken to avoid the formation of*

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* The cistern of the barometer is 125 feet above the approximate mean water-level at Somerset House.

sulphurous acid ; this additional quantity must necessarily be found, as M. Ribau first suggested, by the reaction $C_{10}H_{16} + H_2SO_4 = 2H_2O + SO_2 + C_{10}H_{14}$.

Chemical Laboratory, St. Mary's Hospital, W.
Jan. 11, 1874.

THE CHEMICAL CONSTITUTION OF CITRIC ACID AND ITS NUMEROUS DERIVATIVES,

CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

This paper is a continuation of my researches into the molecular structure of that particular class of organic water-salts which derive from the olefine-begotten polyatomic alcohols. It is by a train of reasoning similar to what I pursued when treating on the heterologues of the tri- and tetratomic alcohols that I shall next endeavour to expound the molecular changes which, in the living organism, are supposed to attend the slow and gradual combustion of the penta- and hexatomic alcohols. And here the proper treatment of my subject demands that I should draw into the circle of the present enquiry another and, to judge from its saturating capacity, a strictly tetratomic alcohol.

Let us first of all understand that, with one single exception, all the parent alcohols of the two schemes that precede, and the three schemes that follow, occupy the *first* place in their respective series, whence their principals are represented by a molecule of *methylic* ether, whereas the exceptional parent alcohol, viz., the tetratomic amylen erythrol, occupies the *second* place in the series, whence its principal is represented by a molecule of *ethylic* ether. Owing to the vast number of heterologues that each parent alcohol is capable of producing, I have been obliged to resort to the device of a "general guide," and by excluding from my schemes the de-alcoholic and monobasic derivatives, I have been enabled to construct for the first and second scheme a list of all the theoretically possible bibasic water-salts, and for the third scheme a similar list of all the theoretically possible tribasic water-salts.

These points being settled, I shall now proceed to acquaint the reader with the leading topics of my programme, which consists of two parts. In the first part, I shall elucidate the molecular changes that accompany the artificial production of certain bibasic and tribasic water-salts, identical with or closely related to the water-salts of pyro-tartaric, pyro-citric, and citric acids. In the second part, I shall contemplate the effects of heat on the ordinary citrate of water, as also the effects of oxidising and reducing agents on the three pyro-citric isomerides. After these preliminaries, I shall at once direct the reader's attention to the contents of the first part.

Part I.

On the Principal Molecular Changes that accompany the Artificial Production of certain Bibasic and Tribasic Water-Salts, identical with or closely related to the Water-Salts of Pyro-Tartaric, Pyro-Citric, and Citric Acids.

It is necessary that I should inaugurate the discussion with a representation of the three schemes above alluded to. These schemes are composed of a network of chemical formulæ, which form the theoretical basis of reasoning, and to which I shall have frequent occasion of referring in the sequel. As to their proper use and meaning, the reader is requested to consult the explanatory note at the close of the preceding paper.

General Guide.

Water-salts.		Affixes -ite.	 -éite.	 -ate.	 -éate.	 -oate.
Bibasic	Meta series	1⌣3	3⌣3	3⌣5	5⌣5	—
	Ortho series	1⌣1	1⌣3	3⌣3	3⌣5	—
Tribasic	Meta series	1⌣1⌣3	1⌣3⌣3	1⌣3⌣5	3⌣3⌣5	3⌣5⌣5
	Ortho series	1⌣1⌣1	1⌣1⌣3	1⌣3⌣3	3⌣3⌣3	3⌣3⌣5

First Scheme.

Tetratomic System.

Parent alcohol :

Amylen-erythrol—

$$\begin{array}{l} \qquad\qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha)\ \overline{2(H_4C_2:C_2);H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;H_2O_2.} \\ \beta)\quad 2H_4C_4; \end{array}$$

Bibasic water-salts :

a Meta-erythrite—

$$\begin{array}{l} \qquad\qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha)\ \overline{2(H_2C_2:C_2);H_2O_2\smile 2C_2;H_2O_2:2H;2C_2O\smile 2H;2C_2O_3.} \\ \beta)\quad 2H_2C_4; \end{array}$$

b Ortho-erythrite—

$$\begin{array}{l} \qquad\qquad\qquad H_2O_2. \qquad\qquad\quad H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \alpha)\ \overline{2(H_2C_2:C_2);H_2O_2\smile 2C_2;H_2O_2:2C_2O\smile 2C_2O.} \\ \beta)\quad 2H_2C_4; \end{array}$$

b Meta-erythrite—

$$\begin{array}{ll} \gamma)\quad 2H_2C_6; & H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha)\ 2(H_2C_2:C_2:C_2); & \overline{H_2O_2:2H;2C_2O\smile 2H;2C_2O_3.} \\ \beta)\quad 2(H_2C_4:C_2); & \end{array}$$

c Ortho-erythrite—

$$\begin{array}{ll} \gamma)\quad 2H_2C_6; & H_2O_2.\ H_2O_2.\ H_2O_2. \\ \alpha)\ 2(H_2C_2:C_2:C_2); & \overline{H_2O_2:2C_2O\smile 2C_2O.} \\ \beta)\quad 2(H_2C_4:C_2); & \end{array}$$

Second Scheme.

Pentatomic System.

Parent alcohol :

Amylen-citracol—

$$\begin{array}{l} \qquad H_2O_2. \qquad\qquad H_2O_2. \\ \overline{2H_2C_2;H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;} \end{array}$$

$$\begin{array}{l} \qquad H_2O_2. \qquad\qquad H_2O_2. \qquad\qquad H_2O_2. \\ \overline{H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;H_2O_2.} \end{array}$$

Bibasic water-salts :

a Meta-citraconite—

$$\begin{array}{l} \qquad H_2O_2. \qquad\qquad H_2O_2. \\ \overline{2C_2;H_7O_2\smile 2C_2;H_2O_2\smile 2C_2;} \end{array}$$

$$\begin{array}{l} \qquad H_2O_2. \qquad\qquad H_2O_2. \qquad\qquad H_2O_2. \\ \overline{H_2O_2:2H;2C_2O\smile 2H;2C_2O_3.} \end{array}$$

b Ortho-citraconite—

$$\begin{array}{l} \qquad H_2O_2. \qquad\quad .\ H_2O_2. \qquad\qquad H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \overline{2C_2;H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;H_2O_2:2C_2O\smile 2C_2O.} \end{array}$$

b Meta-citraconite—

$$\begin{array}{l} \qquad\qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2);H_2O_2\smile 2C_2;H_2O_2:2H;2C_2O\smile 2H;2C_2O_3.} \\ \beta)\quad 2C_4; \end{array}$$

c Ortho-citraconite—

$$\begin{array}{l} \qquad\qquad\qquad H_2O_2. \qquad\qquad\quad H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2);H_2O_2\smile 2C_2;H_2O_2:2C_2O\smile 2C_2O.} \\ \beta)\quad 2C_4; \end{array}$$

c Meta-citraconite—

$$\begin{array}{ll} \gamma)\quad 2C_6; & H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha)\ 2(C_2:C_2:C_2); & \overline{H_2O_2:2H;2C_2O\smile 2H;2C_2O_3.} \\ \beta)\quad 2(C_4:C_2); & \end{array}$$

d Ortho-citraconite—

$$\begin{array}{ll} \gamma)\quad 2C_6; & H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \alpha)\ 2(C_2:C_2:C_2); & \overline{H_2O_2:2C_2O\smile 2C_2O.} \\ \beta)\quad 2(C_4:C_2); & \end{array}$$

Third Scheme.

Hexatomic System.

Parent alcohol :

Hexylen-citrol—

$$\begin{array}{l} \qquad H_2O_2. \qquad\qquad H_2O_2. \\ \overline{2H_2C_2;H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;} \end{array}$$

$$\begin{array}{l} \qquad H_2O_2. \qquad\qquad H_2O_2. \qquad\qquad H_2O_2. \qquad\qquad H_2O_2. \\ \overline{H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;H_2O_2\smile 2C_2;H_2O_2.} \end{array}$$

Tribasic water-salts :

a Meta-citrite—

$$\overset{H_2O_2.\qquad\qquad H_2O_2.\qquad\qquad H_2O_2.}{\overline{2C_2 ; H_2O_2 \smile 2C_2 ; H_2O_2 \smile 2C_2 ; H_2O_2 :}}$$

$$\overset{H_2O_2.\qquad\qquad H_2O_2.\qquad\qquad H_2O_2.}{\overline{2H ; 2C_2O \frown 2H ; 2C_2O \frown 2H ; 2C_2O_3.}}$$

b Ortho-citrite—

$$\overset{H_2O_2.\qquad\qquad H_2O_2.\qquad\qquad H_2O_2.}{\overline{2C_2 ; H_2O_2 \smile 2C_2 ; H_2O_2 \smile 2C_2 ; H_2O_2 :}}$$

$$\overset{H_2O_2.\quad H_2O_2.\quad H_2O_2.}{\overline{2H ; 2C_2O \frown 2C_2O \frown 2C_2O.}}$$

Meta-citrite—

$$\overset{H_2O_2.\qquad\qquad H_2O_2.}{\overline{)2(C_2 : C_2) ; H_2O_2 \smile 2C_2 ; H_2O_2 : 2H ;}}$$

$$\beta)\quad 2C_4 ;$$

$$\overset{H_2O_2.\qquad\qquad H_2O_2.\qquad\qquad H_2O_2.}{\overline{2C_2O \frown 2H ; 2C_2O \frown 2H ; 2C_2O_3.}}$$

c Ortho-citrite—

$$\alpha)\quad \overset{H_2O_2.\qquad\qquad H_2O_2.}{\overline{2(C_2 : C_2) ; H_2O_2 \smile 2C_2 ; H_2O_2 :}}$$

$$\beta)\quad 2C_4 ;$$

$$\overset{H_2O_2.\quad H_2O_2.\quad H_2O_2.}{\overline{2H ; 2C_2O \frown 2C_2O \frown 2C_2O.}}$$

c Meta-citrite—

$$\gamma)\quad 2C_6 ;$$

$$\alpha)\quad 2(C_2 : C_2 : C_2) ; \overset{H_2O_2.\qquad H_2O_2.\qquad H_2O_2.\qquad H_2O_2.}{\overline{H_2O_2 : 2H ; 2C_2O \frown 2H ; 2C_2O \frown 2H ; 2C_2O_3.}}$$

$$\beta)\quad 2(C_4 : C_2) ;$$

d Ortho-citrite—

$$\gamma)\quad 2C_6 ;$$

$$\alpha)\quad 2(C_2 : C_2 : C_2) ; \overset{H_2O_2.\qquad H_2O_2.\quad H_2O_2.\quad H_2O_2.}{\overline{H_2O_2 : 2H ; 2C_2O \frown 2C_2O \frown 2C_2O.}}$$

$$\beta)\quad 2(C_4 : C_2) ;$$

(To be continued.)

EVOLUTION AS APPLIED TO THE CHEMICAL ELEMENTS.

By WILLIAM H. WOOD.

In *Nature* of November 6th Mr. C. T. Blanshard attempts "to explain the close connection that holds between certain of the so-called elements," by means of the hypothesis of evolution. Mr. B. mentions what (he considers) are the chief grounds for holding that the theory explains this connection, and he leaves "the examination into its truth or falsity in the hands of more experienced chemists." As no criticism of Mr. B.'s note by "more experienced chemists" has yet appeared,—though a note by Mr. C. T. Kingzett, calling attention to the fact that similar views have been already made public by himself and others appeared in a recent issue (Chemical News, vol. xxviii., p. 288),—perhaps one who does not lay claim to that title may be allowed to make a few remarks upon it.

It is very necessary that Mr. B. should make correct statements of "the close connection" in question, otherwise his application of the theory of evolution to explain it is worse than useless, because it is simply an explanation of something which does not exist, and may lead some astray. At present I shall content myself with endeavouring to make clear that "the close connection" is not such as Mr. B. states.

The natural group containing *the alkaline metals*, lithium, sodium, potassium, rubidium, and cæsium, is referred to, and, amongst others, this statement is made:—"To the principle that lighter atoms have greater polarity or chemical affinity, Bunsen has found an exception, that cæsium is heavier, and yet more electro-positive, than potassium or sodium." The order, then, in this group is (according to Mr. B.) that Li, having a lighter atom, has greater polarity or chemical affinity, or is more electro-positive than Na, Na for the same reason more than K, and that this holds generally in groups; but in this group Cs is the single exception—admitted by Mr. B. on Bunsen's authority. Is this really the case? All the chemical authorities I can consult—Gmelin, Miller, Frankland, Odling, Naquet, and others—agree in their statements as to the facts embodied in the following table:—

	Order of Polarity, Chemical Affinity, or Electro-positiveness.	Atomic Weight.	Fusing-Point.	Atomic Heats.	Specific Heats.
			° C.		
Lithium ..	1. Lowest	7·0	180·0	6·58	0·940
Sodium ..	2.	23·0	97·6	6·75	0·293
Potassium	3.	39·1	62·5	6·61	0·169
Rubidium	4.	85·3	38·5	—	—
Cæsium ..	5. Highest	133·0	—	—	—

It appears, from this table, that the rule as regards this group is just the opposite to what Mr. B, lays down, the chemical affinity *increasing* as the atom becomes heavier.

Another statement, made under the head of "Heat," is, that "with the elements taken according to natural groups, the greater the atomic weight the higher the fusing or boiling-point." This statement, tested by the above table, does not hold so far as it concerns the fusing-points of the first four elements of the group; it is, in fact, just the reverse. Arsenic, antimony, and bismuth are cited in the paper as examples bearing out this statement, but it does not appear that they do so, their fusing-points being As (atomic weight 75), "between the melting-points of antimony[*] and silver"[†] (Mallet),[‡] under pressure; Sb about 1150° F. (Miller), and Bi 507° F. (Rudberg). The same being the case with mercury, cadmium, and zinc, as Mr. B. admits, renders the statement a rather doubtful one.

Then it is stated that there is a "lessening of the atomic heat, with increase of mass" (the mass being here the atomic weight), but this is not borne out in the case of Li, Na, and K; the atomic heat of Na being (as will be seen from the table) higher than that of Li; and even that of K, though less than that of Na, is higher than that of Li. How does Mr. B. account for these discrepancies between the facts and his statements?

Another group to which reference is made is that of *the Halogens*, chlorine, bromine, and iodine. Here it appears that the rule the greater the atomic mass and the less the affinity holds, as also that referring to the fusing and boiling points; when we compare the atomic heats, however, we find that that of I is higher (6·87) than that of Br (6·74), instead of being lower, as according to Mr. B. it should be. Perhaps this may appear to be the rule to Mr. B. if he is content with such inaccurate statements as that the atomic weight of Br is 81. It appears likely Mr. B. has written *atomic heat* instead of *specific heat*; if so, the amended statement may be correct.

In comparing *the alkaline metals* and *the Halogens*, Dr. Miller makes the following pertinent remarks ("Chemistry," vol. ii., p. 337):—"In treating of the groups of the non-metallic and electro-negative elements, it has been remarked that the electro-negative character of those belonging to the same group is most strongly marked in those which have the lowest combining number—chlorine, for example, being more active than bromine, and bromine than iodine. With the basylous or electro-positive elements the reverse generally holds good; the basic power of rubidium, for example, being greater than that of potassium, that of potassium greater than that of sodium, and that of sodium being superior to the basic power of lithium."

We are told that "It is only with the more specialised of the metals, those which we have seen have massive atoms, that hydrogen will unite, viz., antimony and arsenic; and the compound it forms with the former is very unstable." Now the atomic weight of Sb is 122, that of As 75. The atom of the latter is certainly not massive, comparatively speaking, and that of Sb not particularly so. Mr. B. does not show that SbH_3 is more unstable than AsH_3, and if, as we find it stated, both these compounds require exposure to nearly a red heat to decompose them, the "very unstable" nature of SbH_3 does not seem to be proven. Copper (atomic weight 63·5) forms a compound with hydrogen, Cu_2H_2, in addition to Sb and As, but the atom of Cu is not massive, though, if Mr. B. is to be believed, it is one of "the more specialised metals," and this combination shows its "comparatively non-metallic nature."

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[*] Sb melts about 1150° F. (Miller).

[†] Aq melts at 1873° F. (Daniell).

[‡] Chemical News, vol. xxvi., p. 97.

"Hydrogen" is stated to have "the greatest conducting power of all gases"—*for heat* is to be understood from the heading of the section. The experiments made on this point have been to compare the relative cooling effect of air and hydrogen on platinum wire heated to redness by an electric current. The luminosity of the wire is found to be diminished most by the hydrogen. The cooling effect may, however, be attributed to other things as well as to conduction, Tyndall attributing it to the greater mobility of the hydrogen particles, while Magnus favours conduction.

The points enumerated are the more important ones to which I take objection, or call in question. Though I do so, I am not unwilling—nor, I believe, are chemists generally—to consider the application of the theory of evolution, or any other, to explain the relations really known to exist among the chemical elements, since observation from new standpoints frequently results in more truthful views being gained, and thus the domain of scientific truth is gradually contended.

Halifax, Dec. 22, 1873.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 15, 1874.

Dr. Odling, F.R.S., President, in the Chair.

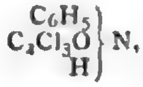
The minutes of the previous meeting having been read and confirmed, Dr. Tommasi, and Messrs. Charles L. Field, J. L. Player, and Edward Collens were formally admitted Fellows of the Society.

The donations were then announced, including a Chinese translation of the article "Gunpowder" from Watts and Richardson's "Technology," and the following names were read for the first time:—Messrs. John George Lyon, Francis J. W. Polglase, Magnus Ohren, Harry Grimshaw, William Carleton Green, Henry Tanner, Colonel William Boyle, Thomas Carnelly, B.Sc., and Alexander H. Sexton.

For the third time—Messrs. Frederick E. Harman, William Herbert Pike, Robert Frazer Smith, Henry Bowman, Joseph Reddross, R. L. Taylor, William Joseph Spratling, Dr. J. Lawrence Smith, and Owen Davies Owen, who were ballotted for and duly elected.

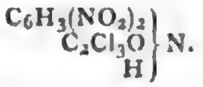
Mr. W. C. Roberts handed in a table supplementary to his paper read at the last meeting, and containing complete analyses of all the standard trial-plates still extant, dating from A.D. 1477—namely, seventeen gold plates and fourteen silver ones.

The first paper, "*On the Action of Trichloracetyl Chloride on Amines* (I., *Action on Aniline*)," by D. Tommasi and R. Meldola, was read by the latter. After noticing the various bromine and chlorine derivatives of phenyl acetamide which had hitherto been obtained, the authors give details of the process—a modification of Gal's—by which the trichloracetic acid was prepared from chloral hydrate by the action of fuming nitric acid. The trichloracetyl chloride was obtained from the acid by means of phosphorus trichloride. Aniline, when added to excess of the chloride, causes great elevation of temperature, and, on further application of heat, hydrochloric acid is given off, and the liquid assumes a dark brown colour. On cooling, it solidifies to a crystalline mass of phenyl trichloracetamide—



$$\left.\begin{matrix} C_6H_5 \\ C_2Cl_3O \\ H \end{matrix}\right\} N,$$

which is washed with water, and crystallised from hot alcohol. The new amide forms small lustrous rhomboidal plates, which melt at 94° C. It is soluble in benzene, and very soluble in carbon disulphide, ether, and chloroform. Boiled with caustic soda, the amide is decomposed, with formation of a basic substance of penetrating odour. The action of alcoholic ammonia appears to produce the same substance. The amide dissolves in cold fuming nitric acid, but the solution rapidly becomes hot, and evolves nitrous fumes in abundance; on boiling the mixture a short time, and then pouring the product into water, a substance is obtained which crytallises from hot alcohol in tufts of yellow needles, having the composition—



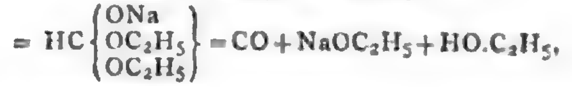
$$\left.\begin{matrix} C_6H_3(NO_2)_2 \\ C_2Cl_3O \\ H \end{matrix}\right\} N.$$

Dinitro-phenyl trichloracetamide fuses at 118° C., and does not explode when strongly heated. It is very slightly soluble in water, readily in benzene, ether, chloroform, and cold dilute alkaline solutions, from the latter of which it is precipitated unaltered on the addition of an acid; when the alkaline solution is boiled, decomposition ensues.

The President said the thanks of the Society were due to Dr. Tommasi and Mr. Meldola for their interesting communication. There was one point, however, in the preparation of the amide about which he would like to make an enquiry; that was, as to whether it was absolutely necessary to use the chloracetyl chloride, or whether chloracetic acid itself would not produce the body; it was well known that in many instances aniline, when heated with the acid, gave the corresponding amide.

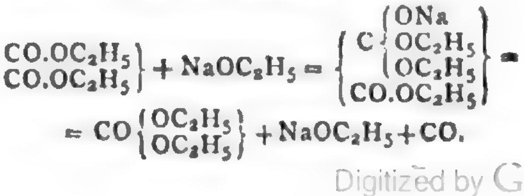
Dr. H. E. Armstrong then read a "*Note on the Action of Sodic Ethylate on Ethylic Oxalate and other Ethereal Salts.*" Dittmar and Cranston have shown that, when ethylic oxalate is warmed with sodic or potassic ethylate, it is in great part resolved into carbonic oxide and ethylic carbonate. Very nearly equal molecular weights of these two products are obtained, the conclusion being that the reaction was a so-called catalytic one, *i.e.*, a cycle of reactions in which the ethylate is continuously decomposed and reproduced, and that a given weight of ethylate could decompose an unlimited quantity of oxalate, if it were possible to exclude certain other reactions which go on simultaneously with the principal one and gradually consume the ethylate. Geuther, again, has shown that ethylic formate is converted into carbonic oxide and ethylic alcohol under similar circumstances. Dr. Armstrong suggests that these decompositions may readily be explained, if we assume that the ethylate first combines with the ethereal salt, and that the compound thus formed is afterwards broken up on heating; for instance, the reaction with ethylic formate would be—

$$HCO.OC_2H_5 + NaOC_2H_5 =$$



$$= HC\left\{\begin{matrix} ONa \\ OC_2H_5 \\ OC_2H_5 \end{matrix}\right\} = CO + NaOC_2H_5 + HO.C_2H_5,$$

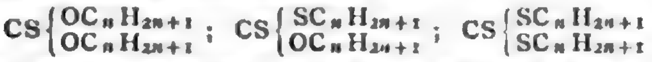
and in the case of ethylic oxalate—



$$\left.\begin{matrix} CO.OC_2H_5 \\ CO.OC_2H_5 \end{matrix}\right\} + NaOC_2H_5 = \left\{\begin{matrix} C\left\{\begin{matrix} ONa \\ OC_2H_5 \\ OC_2H_5 \end{matrix}\right. \\ CO.OC_2H_5 \end{matrix}\right\} =$$

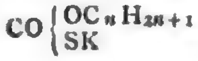
$$= CO\left\{\begin{matrix} OC_2H_5 \\ OC_2H_5 \end{matrix}\right\} + NaOC_2H_5 + CO.$$

The same interpretation may be given of the decomposition of the ethereal salts of the form—



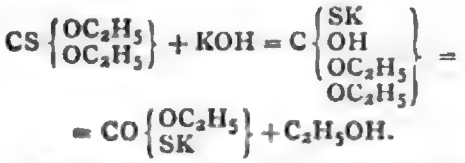
$$\mathrm{CS}\left\{\begin{matrix}\mathrm{OC}_n\mathrm{H}_{2n+1}\\ \mathrm{OC}_n\mathrm{H}_{2n+1}\end{matrix}\right. ; \quad \mathrm{CS}\left\{\begin{matrix}\mathrm{SC}_n\mathrm{H}_{2n+1}\\ \mathrm{OC}_n\mathrm{H}_{2n+1}\end{matrix}\right. ; \quad \mathrm{CS}\left\{\begin{matrix}\mathrm{SC}_n\mathrm{H}_{2n+1}\\ \mathrm{SC}_n\mathrm{H}_{2n+1}\end{matrix}\right.$$

by potassium hydrate dissolved in alcohol, all of which, as Salmon has recently shown, yield compounds of the form—



$$\mathrm{CO}\left\{\begin{matrix}\mathrm{OC}_n\mathrm{H}_{2n+1}\\ \mathrm{SK}\end{matrix}\right.$$

Thus—



$$\mathrm{CS}\left\{\begin{matrix}\mathrm{OC_2H_5}\\ \mathrm{OC_2H_5}\end{matrix}\right\} + \mathrm{KOH} = \mathrm{C}\left\{\begin{matrix}\mathrm{SK}\\ \mathrm{OH}\\ \mathrm{OC_2H_5}\\ \mathrm{OC_2H_5}\end{matrix}\right\} =$$

$$= \mathrm{CO}\left\{\begin{matrix}\mathrm{OC_2H_5}\\ \mathrm{SK}\end{matrix}\right\} + \mathrm{C_2H_5OH}.$$

Professor **Odling**, when thanking the author, said that, *prima facie*, it appeared to him that the nature of the reaction was most probably that suggested by Dr. Armstrong.

The last paper, "*On the Products of Decomposition of Castor Oil* (No. I., *Sebasic Acid*)," was read by the author, Mr. E. **Neison**. The action of heat on sodium ricinoleate, obtained by treating castor oil with an equal weight of sodium hydrate, produces crude sodium sebate. The acid may be separated from this in the pure state by two methods detailed by the author. It forms feathery crystals or brilliant laminæ, soluble in 1500 parts of water at 10°, and in 22 parts at a boiling heat; it is readily soluble in alcohol and ether. It is not decomposed by boiling with nitric acid for a few hours, nor by digestion with potassic dichromate and sulphuric acid. Of the two classes of salts formed by sebasic acid, the neutral would appear to be the most stable. The author has prepared and analysed many of these, including potassium hydrogen sebate, potassium sebate, sodium hydrogen sebate, sodium sebate, two barium sebates, two strontium sebates, two calcium sebates, two magnesium sebates, zinc sebate, aluminium hydrogen sebate, cobalt, nickel, lead, and copper sebate, mercurous sebate, mercuric sebate, and silver sebate.

The **President** thanked the author for his contribution to our knowledge of this acid, which was to be welcomed, as it formed almost the last known acid of the series, and could be obtained so readily from castor oil.

Mr. **Neison**, in reply to questions by Dr. **Mills** and Dr. **Wright**, said that it was only his first paper on the subject, containing a description of the acid and its salts. Nitric acid did not change sebasic acid if boiled with it for several hours.

The meeting was finally adjourned until Thursday, Feb. 5, when there will be a paper, "On the Action of Benzyl Chloride on Camphor," by Dr. D. Tommasi.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 16th, 1873.

E. W. **Binney**, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. **James Heelis** was elected an Ordinary Member of the Society.

The **Chairman** said that since the last meeting the Society had lost one of its most illustrious members by the death of Professor Louis Agassiz, the great naturalist, who had been an Honorary Member for above thirty years. He (the Chairman) had the honour of being personally acquainted with the deceased, having been brought into communication with him during the publication of his great work, "Recherches sur les Poissons Fossiles," and having had the pleasure of supplying him with specimens for its illustration. In the Royal Society's Catalogue is a list of 130 scientific memoirs he gave to the world. The reputation of Agassiz as one of the foremost men of his day in natural history is too well known to need any tribute from me, but after a lapse of thirty years his amiable manners and his great kindness in cheerfully imparting his vast stores of knowledge to the humblest student are fresh in my memory. He was one of the kindest and heartiest of men, and his fine and manly countenance at that time was the picture of health and good nature, and truly reflected the genial soul within. In great and small matters he was equally punctual and correct. All who ever allowed him to make use of their specimens must well remember the ample acknowledgments he made and the scrupulous care with which they were returned, and some of the first living palæontologists might learn a useful lesson in this respect from the illustrious dead. With Agassiz it may be truly said that it was hard to decide whether his head or his heart most deserved our admiration. The world has to lament the death of a great and good man, and this Society one of its greatest ornaments.

"*Method of Construction of a New Barometer*," by J. P. **Joule**, D.C.L., LL.D., F.R.S., &c., President.

The condition of the instrument placed on March 18 in the Society's Hall proves that it is possible to use sulphuric acid on the top of the mercurial column without chemical action taking place. I have therefore proceeded to prepare other tubes with a view to test, by practical work, the merits of the new contrivance.

A tube of about 3-16th inch bore is selected. It is first cleaned by drawing a knotted string through it. It is then bent to the syphon shape, and near the longer end it is drawn to a capillary tube. It is then washed with nitric acid, afterwards with sulphuric acid. The sulphuric acid is then drained off. Mercury is then poured into the short limb. The end of the longer limb is then attached to my mercurial exhauster. On working this, the mercury rises in the tube, and, being replenished by pouring it into the short limb, soon arrives at the height due to the atmospheric pressure. It carries with it the acid left adhering to the sides, so that, after a few hours, half, or, what is better, one-third, of an inch of acid stands above the mercury. Small bubbles of air are seen to arise, but, by leaving the tube in connection with the exhauster for a day or two, these finally cease. Mercury is then poured into the short limb until that in the longer rises nearly to the capillary part of the tube. This is then sealed and detached from the exhauster. Mercury is then removed from the shorter limb until it stands in the long one at a convenient height. Sulphuric acid is then introduced into the short limb until it forms a column equal to that in the longer limb. A small tube is finally attached to the short limb, and dipping a little way into a small bottle containing a small quantity of sulphuric acid, prevents the access of moist air into the short limb.

The tube thus completed possesses the following advantages:—1. There is the utmost facility in the movement of the column, so that the most minute changes of pressure are at once registered without any dragging. 2. The depression produced by capillary action is reduced to one-half, so that the syphon arrangement can be satisfactorily used as affording an accurate neutralisation of capillary action.

Mr. **Brothers** exhibited the plates forming the first part of the Holborn Society's photolith reproduction of Hans Burgman's "Triumphs of Maximilian I." The designs are engraved on wood and printed on separate sheets, but the set shown were mounted so as to exhibit the artist's intention—that of a triumphal procession. This remarkable work is considered to be one of the finest specimens of wood-engraving.

Mr. **Baxendell** read the following letter from Professor C. **Piazzi Smyth**, F.R.S., Astronomer-Royal of Scotland:—

Referring (as the prompt and frequent publications of your Society so easily and agreeably enable one to do) to Professor Osborne Reynolds's triumphant proof, on November 18, that his glass tubes were strong enough to act as guns,—and also that 1·5 inches depth of powder produced nothing like the force exerted by the electrical discharge, and that that electrical discharge acted by means of conversion of water suddenly into steam, as when lightning rends a tree,—may I beg to offer two remarks?

1. The soundness of the discussions before the Society on the recent wood-struck case near Manchester is evident by a similar conclusion arrived at by the British Association when at Edinburgh in 1850; for a tree in the neighbourhood having been struck and specially shattered into thin plates of wood, during the week of congress, was formally examined by a deputation of the Association, and the lightning was held to have exploded the watery matter of the sap-vessels.

2. That water is a far more powerful exploder than gunpowder, if you can get it (the water) to explode at all, is now experimentally proved by Professor Osborne Reynolds's electrical experiments, and did occupy my attention many years ago, on comparing the far larger increase of space occupied by exploded water in the shape of steam than by exploded gunpowder in the shape of its permanent gases.

The difficulty, however, is to get the water to explode, and not to pass off merely into steam—a difficulty well illustrated by any and every accession of dampness to gunpowder fired in the usual way decreasing, instead of increasing, the gunpowder's explosive force.

In order to try to explode water, at that time, I melted a large ladle full of lead, put upon the fluid and almost red-hot surface a drop of water, and tried various devices to bring it under the influence of the heat; but, even when forcibly attempted to be pushed under the melted lead, the water ran with vehemence up the substance of the wooden probe employed, and refused to have anything to do with the fluid lead, which consequently remained undisturbed.

But when I next took a smaller iron ladle, put a drop of water on the bottom of it, and gave therewith a little pat to the surface of the melted lead, instantly the whole contents of the great ladle were scattered to the winds, and only a few grains were recovered. Explosion of water had apparently taken place with excellent effect.

Then came a question as to repeating such an explosion at small intervals of time in a safe manner, so as to have an explosion-engine, in which, if all the heat of the coal could be used in exploding water rather than in raising steam, a surprising economy of fuel should result.

But as no progress was made in such an engine, I can only refer to some old accounts of an explosion in a copper foundry, where the great establishment was literally blown up, it was said, by a workman simply spitting into a vessel of melted copper. The mere amount of steam raised from the saliva would evidently have been of no practicable avail for either good or evil, even if employed in the best modern expansive engine on the thermo-dynamic principles; but, as an explosive, its energy would seem to have been so vast that I must hope for further development of the subject at the hands of the able men of science in the Manchester Literary and Philosophical Society.

"*On the Destruction of Sound by Fog and the Inertness of a Heterogeneous Fluid,*" by Professor OSBORNE REYNOLDS, M.A.

1. That sound does not readily penetrate a fog is a matter of common observation. The bells and horns of ships are not heard so far during a fog as when the air is clear. In a London fog the noise of the wheels is much diminished, so that they seem to be at a distance when they are really close by. On one occasion during the launch of the *Great Eastern* the fog was reported so dense that the workmen could neither see nor *hear*.

2. It has also been observed that mist in air or steam renders them very dull as regards motion. This is observed particularly in the pipes and passages in a steam-engine. Mr. D. K. Clark found in his experiments that it required from three to five times as much back-pressure to expel misty steam from a cylinder as when the steam was dry.

3. My object in this paper is to give and to investigate what appears to me to be an explanation of these phenomena, from which it appears that they are intimately connected—that, in fact, they are both due to the same cause. This explanation will be the clearer for a few preliminary remarks.

4. The nature of a fog, and the manner in which the small spherical drops are suspended against their weight, is well understood. So long as the fog is at rest, or moving uniformly, the drops, being heavier than the air, tend to sink like a stone in water, and consequently they are not at rest in the air, but are moving through it with greater or less velocities, according as they are large like rain, or small like haze. This motion is caused entirely by the difference in the specific gravity of the air and water; if the drops were merely little hard portions of air, they would have no tendency to descend.

In some fogs the drops are so fine that they appear to be absolutely at rest, and will remain for a long time without any appreciable motion. The force which retards the downward motion of the drops is the friction of the air, and this is proportional to the surface of the drop and the square of the velocity. As the drops get smaller, their weight diminishes faster than their surface, and consequently the friction will balance the weight with a less velocity. The exact law is that the velocity caused by the weight of a drop is proportional to the square root of its diameter.

This is the general explanation of what goes on under the action of gravity when the fog is at rest, or moving uniformly, and we may make use of it to illustrate what goes on when the fog is subjected to accelerating or retarding forces.

5. If we imagine a vessel, full of such a compound as the fog is made of, to be set in motion or stopped, the accelerating or retarding force will have to be transmitted from the sides of the vessel to the fluid within it by means of pressure. These pressures will act equally throughout the fluid, and if the fluid were homogeneous they would produce the same effect throughout it, and it would all move together, but the pressures will obviously produce less effect on the drops of water than they do on the corresponding volumes of air, and the result will be that the drops of water will move with a different velocity to the air—that the drops of water will, in fact, move through the air, just as they do under the action of gravity. In fact, if the air is subject to an acceleration of 32 feet per second, the effect on the drops (their motion through the air) will be the same as that due to their weight. It is easy to conceive the action between the air and the drops of water. If a mass of air and water is retarded it is obvious that the water, by virtue of its greater density, will move on through the air. This property has, in fact, been made use of to dry the steam used in steam-engines. The steam is made to take a sharp turn, when the water, moving straight on through it, is deposited on the side of the vessel.

6. Owing to this motion of the water through the air, it would clearly take longer with the same force to impress the same momentum on foggy air than on the same when dry. This is obvious, for at the end of a certain time the particles of water would not be moving as fast as the air, and consequently the air and water would have less momentum than the same weight of dry air all moving together; that is to say, if we had two light vessels containing the same weight of fluid, the one full of dry air and the other full of fog, and both subjected to the same force for the same time, and at the end of this time, although they would have exactly the same motion, their contents would not, for the drops of water in the fog would not be moving so fast as the vessel. Now the energy expended on each of these vessels would be the same, but, inasmuch as the effects are different, the energy acquired by the foggy air would be less than that acquired by the dry air, the difference having gone to move the water through the air; that is to say, it would require more pressure to impress, in the same time, the same velocity on foggy air than on dry air of the same density.

7. This, then, fully explains the dulness with which foggy air acquires motion. In the passages of a steam-engine the steam is subjected to continual accelerations and retardations, each of which requires more force in the manner described with misty than with dry steam, and at each of which the particles of water moving through the steam destroy energy in creating eddies.

8. Although not so obvious, the same is true in the case of sound. The effect of waves of sound traversing a portion of air is first to accelerate and then to retard it. And if there are any drops of water in the air these will not take up the motion of the air so readily as the air itself. They will allow the air to move backwards and forwards past them, and so cause friction and diminish the effect of the wave as it proceeds, just as a loose cargo will diminish the rolling of a ship.

9. It is important to notice that this action of the particles of water is not analogous to their action in reflecting the waves of light.

It has been assumed, as an explanation of the action of fog on sound, that the particles of water break up the wave of sound by small reflections in the same way as they scatter the waves of light. The analogy, however, is not admissible; for in the case of light the wave-length is shorter than the thickness of the drops, and the surface of the drop act in the same way as if the drop were of large extent; but in the case of sound, the wave's length may be thousands of times the thickness of the drop, and instead of the whole wave being reflected it will only be a very small portion of it. Even this portion can hardly be called a reflection; it is due to the motion of the air past the drops, like the waves of sound caused by a bullet, or the waves thrown off by the bow of a ship.

10. A certain portion of the resistance which the air offers to the motion of the water through it is this—what is called in naval science *wave resistance*; but it can be shown that the proportion of this resistance to the resistance in causing eddies diminishes with the velocity, and consequently it can have very little to do with the effect of the drops of water on the waves of sound, in which the velocity of the water through the air must be very small.[*]

11. So far, then, I have shown the manner in which the fog diminishes the sound; it remains to consider the connection between the size of the drops and their effects. I am not aware that any observations have been made with respect to this. I do not know whether it has ever been noticed whether a fine or a coarse mist produces the most effect on sound. It does not appear, however, that rain produces the same effect as fog; and considering rain as a coarse fog, we must come to the conclusion that a certain degree of fineness is necessary.

If we examine theoretically into the relation between the size of the drops and the effect they produce, always assuming the same quantity of water in the air, we find in the first place that if the air is subjected to a uniform acceleration, which acts for a sufficient time for the drops to acquire their maximum velocity through the air, the effect of the drops in a given time—that is to say, the energy dissipated in a given time—is proportional to the square root of the diameters of the drops. This appears from the action of gravity. As previously stated, the maximum downward motion of the drops, and hence the distance they will have fallen in a given time, and the energy destroyed is proportional to the square root of their diameters. Hence, where the acceleration acts continuously for some time, as would be the case in a steam pipe, the effect will increase with the size of the drops.

This effect may be represented by a parabolic curve, in which distances measured from the vertex along the axis represent the size of the drops and the corresponding ordinates represent their effect in destroying energy.

If, on the other hand, the acceleration alternates very rapidly, then there will not be time for the drop to acquire its maximum velocity, and if the time be very short the drop will practically stand still, in which case the effect of the drops will be proportional to the aggregate surface which they expose. And this will increase as the diameter diminishes, always supposing the same quantity of water to be present.

This latter is somewhat the condition when a fog is traversed by waves of sound, so long as the drops are above a certain size; when, however, they are very small, compared with the length of the waves, there will be time for them to acquire their maximum velocity. So that, starting from drops the size of rain, their effect will increase as their size diminishes, at first in the direct proportion, then more and more slowly until a certain minuteness is reached, after which, as the drops become still smaller, their effect will begin to diminish, at first slowly, but in an increasing ratio, tending towards that of the square root of the diameter of the drops.

This effect may be represented by a curve which coincides with the previously described parabola at the vertex, but which turns off towards the axis, which it finally approaches as a straight line.

This completes the investigation, so far as I have been able to carry it. The complete mathematical solution of the equations of motion does not appear to be possible, as they are of a form that has not as yet been integrated. However, so far it appears to me to afford a complete explanation of the two phenomena, and further to show, a fact not hitherto noticed, that for any note of waves of sound there is a certain size of drop with which a fog will produce the greatest effect.

"*The Chemical Constitution of Bleaching-Powder*," by C. SCHORLEMMER, F.R.S.

In his classical research "On the Compounds of Chlorine with Bases,"[†] Gay-Lussac has shown that the bleaching compounds formed by this reaction are not direct combinations of chlorine and a base, as Berthollet believed, but that a hypochlorite and a chloride are produced simultaneously, according to the equation—

$$2\mathrm{KOH}+\mathrm{Cl}_2=\mathrm{KOCl}+\mathrm{KCl}+\mathrm{H}_2\mathrm{O}.$$

When to the compounds thus formed, a small quantity of a mineral acid is added, hypochlorous acid is set free, whilst by adding the acid in excess chlorine is obtained; because in the latter case the hydrochloric acid acts on the hypochlorous acid in the following way:—

$$\mathrm{ClH}+\mathrm{ClOH}=\mathrm{Cl}_2+\mathrm{H}_2\mathrm{O}.$$

As a ready method for preparing a dilute solution of hypochlorous acid, Gay-Lussac recommends to distil a solution of bleaching-powder with a quantity of dilute nitric acid which is just sufficient to liberate the hypochlorous acid.

According to Gay-Lussac's view, bleaching-powder is a mixture of calcium chloride and calcium hypochlorite, and the same view is held by most chemists. Professor Odling has, however, pointed out that, calcium being a dyad metal, the constitution of bleaching-powder was probably—

$$\mathrm{Ca}\begin{cases}\mathrm{Cl}\\ \mathrm{OCl},\end{cases}$$

or it was at the same time a hypochlorite and a chloride. Of course both views explain equally well the formation of hypochlorous acid by Gay-Lussac's method. I read, therefore, with great surprise a paper by Goepner (*Dingler's Polytech. Journ.*, 209, 204), in which he states that bleaching-powder is nothing but a simple combination of lime and chlorine, which by acids is again resolved into its constituents without the least trace of hypochlorous acid being formed. He says that, although the preparation of hypochlorous acid by this method is described in all handbooks as if this experiment had been made hundreds of times, this is a mistake, and the reason why this error has maintained itself so long in chemical literature is that hitherto no reaction was known by which free chlorine and hypochlorous acid could be readily distinguished. But such a reaction has now been found by Wolters, who has shown that when chlorine-water is shaken with an excess of mercury only mercurous chloride is formed, while with aqueous hypochlorous acid it yields a brown crystalline oxychloride of mercury, which is readily soluble in hydrochloric acid, and thus offers a ready means of the qualitative as well as quantitative determination of hypochlorous acid in the presence of free chlorine.

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[*] This reflection has nothing to do with the reverberation from clouds which occurs in a thunderstorm, which is probably due to the different density of the clouds, and takes place at their surfaces.

[†] *Comptes Rendus*, xiv., 927.

In employing this reaction for detecting hypochlorous acid in the liquid which was obtained by distilling bleaching-powder with a small quantity of hydrochloric or sulphuric acid, Goepner could not find a trace of hypochlorous acid, but only free chlorine.

I have already mentioned that he says the preparation of hypochlorous acid by this method is described in the books as if this experiment had been repeated hundreds of times. Now this experiment has been repeated many hundred times in our laboratory only. Professor Roscoe shows it every year in his lectures, and all our students in the course of their practical work perform it, and find that the perfectly colourless distillate is a much more powerfully bleaching agent than freshly prepared chlorine-water. This is quite sufficient to show that the liquid contains hypochlorous acid. But why did Goepner fail in detecting it? Perhaps it was the fault of the analytical method? To decide these questions, I prepared hypochlorous acid by distilling solutions of bleaching-powder with dilute nitric and sulphuric acid and shook the colourless distillates with mercury. In every case the brown oxychloride was formed in quantity and possessed all the properties which Wolters has assigned to it, while by shaking chlorine-water with mercury only calomel was formed. From a careful perusal of Goepner's paper I was unable to find the cause of his failure.

Another argument against the existence of a hypochlorite in bleaching-powder is, according to Goepner, the following. The chlorine which is used in the manufacture of bleaching-powder always contains free hydrochloric acid, and thus in bleaching-powder more calcium chloride will always exist than would correspond with Gay-Lussac's formula. Now when bleaching-powder is exhausted successively with small quantities of water, the excess of calcium chloride is always found in the first solutions, whilst those following contain calcium and chlorine in the proportions corresponding to the empirical formula $CaOCl_2$. This fact, however, only proves that bleaching-powder is not a mixture of calcium chloride and hypochlorite, but that the bleaching compound contained in it has the constitution which Professor Odling has assigned to it.

Professor Williamson has shown that an aqueous solution of hypochlorous acid may also be obtained by suspending finely-divided calcium carbonate in water, and passing chlorine into the liquid until the carbonate is dissolved, and then distilling the solution. In this reaction the compound Ca(OCl)Cl is probably also first formed and acted on by an excess of chlorine in the following way:—

$$Ca\begin{cases}Cl\\OCl\end{cases}+Cl_2=Ca\begin{cases}Cl\\Cl\end{cases}+Cl_2O.$$

MISCELLANEOUS.

Dr. Huggins, F.R.S.—The Emperor of Brazil has conferred upon Dr. Huggins, F.R.S., the distinction of Commander of the Order of the Rose.

Letts's Diaries.—The diaries for 1874 published by this eminent firm are useful for gentlemen engaged in the various professions, and also for private use. Some of the bindings are excellent.

MEETINGS FOR THE WEEK.

Monday, Jan. 26.—Medical, 8.
— Geographical, 8½.
— London Institution, 4.
Tuesday, 27.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."
— Civil Engineers, 8.
— Anthropological Institution 8. (Anniversary.)
Wednesday, 28.—London Institution, 7.
— Society of Arts, 8.
Thursday, 29.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8½.
— Philosophical Club, 6.
Friday, 30.—Royal Institution. Weekly Meeting, 8.
— Royal Institution, 9. Sir Julius Benedict, "Weber and his Times."
Saturday, 31.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

Now ready, Illustrated, fcap. 8vo., 2s. 6d.,

Analysis of Water, Milk, &c. Practical EXAMPLES in QUANTITATIVE ANALYSIS, forming a concise guide to the Analysis of Water, &c.

By ERNEST FRANCIS, F.C.S.
Demonstrator of Practical Chemistry, Charing Cross Hospital.

⁂ "The book is crowded with useful information, and we can very safely recommend it to our readers."—The Lancet, July 5th, 1873.

London: H. K. LEWIS, 136, Gower Street.

Now Ready, Price 5s.,

Milk-Analysis.—A Practical Treatise on the Examination of Milk (including Cream, Butter, and Cheese). By J. Alfred Wanklyn, M.R.C.S., Corresponding Member of the Royal Bavarian Academy of Sciences, Public Analyst for Bucks.

London: TRUBNER and CO., Ludgate Hill.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson and Henry Watts. Second Edition, illustrated with numerous Wood Engravings.

Vol. I., Parts 1 and 2, price 36s., with more than 400 Illustrations.

Nature and Properties of Fuel: Secondary Products obtained from Fuel: Production of Light: Secondary Products of the Gas Manufacture.

Vol. I., Part 3, price 33s., with more than 300 Illustrations.

Sulphur and its Compounds: Acidimetry: Chlorine and its Bleaching Compounds: Soda, Potash: Alkalimetry: Grease.

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Aluminium and Sodium: Stannates, Tungstates, Chromates, and Silicates of Potash and Soda: Phosphorus, Borax: Nitre: Gun-Powder: Gun Cotton.

Vol. I., Part 5, price 36s.

Prussiate of Potash: Oxalic, Tartaric, and Citric Acids, and Appendices containing the latest information, and specifications relating to the materials described in Parts 3 and 4.

Bailliere and Co., 20, King William Street, Strand.

Analysis of Food, Water, and Air.—Mr. WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analysts under the new Act.

South London School of Chemistry and Pharmacy. *Director*—Dr. JOHN MUTER, F.C.S.

Hours of Lecture for Session 1872-73:—

Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
(Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural) ..	11 a.m.	Classics (Junior)	9 a.m.
„ (Systematic) ..	3 p.m.	„ (Senior)	4 p.m.

Laboratory open for Practical Chemistry from 10 till 4.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.
Vol. XXIX. No. 739.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

The subject of the concluding lecture was "Radiant Heat and Mechanical Value of Heat."

Resuming the subject of radiant heat, it is found, that of surfaces equally smooth, some have a greater specific power of radiation than others. The ordinary means for exhibiting this and similar relations of radiating power is by a cube filled with water at the boiling-point, and turning on a vertical axis, and presenting its surface to a susceptible body, such as an air thermometer or pile. The surface of the cube is of lamp-black, of polished gold, of scratched silver and of polished silver, and each surface is brought near the hood of the pile in succession. Lamp-black is thus found to radiate more heat than the polished surfaces. Besides, when the surface of polished gold is coated over with a solution of isinglass, the heat passes through more abundantly, showing that the power of radiation does not depend wholly on the size of the surface, as determined by its roughness, but also on the nature of the surface.

The power of metallic surfaces for reflecting heat may be thus shown:—A sheet of paper is coated partially with gold-leaf on one side, and on the other with iodide of mercury, which has the peculiar property that, when heated, it turns yellow, without undergoing decomposition. Expose this paper to the heat of hot iron, and where the gold-leaf has protected the iodide, it remains red, but where not protected by the metal surface, it is converted into yellow.

The different powers which different substances have for radiating heat is shown in Nature in the formation of dew, and its kindred—we may say identical—phenomena, hoar-frost or frozen dew. Dew is caused by the loss of heat by the earth. After sunset the earth radiates heat through the air into space, and is so cooled that the water vapour in the air condenses on its surface. Accordingly, those parts of the earth's surface which radiate most heat are most thickly covered with dew. But if this radiation of heat from the earth is prevented, dew is not deposited upon it. Thus, on a cloudy night, the dew is not deposited, and one reason is because the heat radiated from the earth strikes the cloud, and is reflected back again on the earth. Another reason is, because, through moist air, the heat of the earth cannot escape as it can when the air is perfectly dry. Clouds, of course, are not watery vapour in the proper sense; they are particles of water itself, whereas water vapour is a perfectly pure transparent gas. This is seen to be the case when steam is heated. In damp muggy weather clouds from a locomotive subsist for a long time, but when the weather is dry, they quickly disappear, remaining as invisible vapour in the air.

In order to determine the quantity of aqueous vapour in the air, use is made of the hygrometer or moisture-measurer, identical in principle with the cryophoros.

It has been already noticed that radiant heat, on striking bodies, experiences either absorption, reflexion, or transmission, and the latter has now briefly to be considered. Bodies may allow light to pass through them with the greatest freedom, but may absorb heat; such bodies are called transparent, and we might call bodies which allow heat to pass through, transcalent, but the Greek diathermancy has been used instead. This word has the same significance with regard to heat as transparency has with regard to light. Rock-salt amongst solids, halogen compounds of carbon amongst liquids, and all simple gases or gaseous mixtures amongst gases, may be taken as types of diathermanous bodies. Bodies may be opaque to light, and yet very diathermanous. The relation is remarkable between the power which different substances have for arresting radiant heat, and their power of transmitting heat by conduction. Thus CS_2, which allows radiant heat to play through it, refuses to allow heat of conduction to pass through it. Those liquids, too, had the greatest thermal resistance which contained Ch, Br, or I, and these allow radiant heat to pass through. Water is the most athermanous, or the body which arrests the greatest proportion of radiant heat, while it conducts heat most abundantly.

It was clearly shown in the analysis of a beam of heat, that the heat is greatest a little beyond the red end of the spectrum; also that one can focus invisible heat just as one can focus cold light, these being independent of one another. With a solution of iodine in CS_2, the light is intercepted by the iodine, whilst the CS_2 allows heat to pass. This heat reveals itself to the hand or to the air thermometer; and by a little extra care we can ignite combustible bodies in the dark by the heat of an electric lamp, or Pt may be made red hot by the voltaic current. Such phenomena are called phenomena of calorescence.

We have been ascustomed to look upon heat hitherto as obtained by chemical change or in the electric lamp as the resistance which the air and carbon particles offer to the passage of electric discharge. Thus 1 pound of H, thoroughly burned to form water, will raise 34462 pounds of water, 1° C. H may be regarded as the most fierce of all bodies, and gives rise to more heat than any other substance when completely burned. Next comes carbon with its 8000 pounds of water raised 1° C. when one pound of carbon is burned. Phosphorus, again, that might be imagined to burn most fiercely, exceeds sulphur, but does not come up to carbon. This plan is used in measuring the value of coal. It is found how much water, say, an ounce of coal will heat, and the carbon in the coal is determined by the quantity of heat developed.

One of the most familiar sources of heat is that by friction, but, curiously enough, it has been the least studied till within the last twenty years. We know that, when two substances are rubbed together heat is produced—when a knife is cleaned by rubbing, when a razor is stropped on a dry horne, when a saw cuts wood, &c. To pursue this point further, take a tube in which there is a piston fitting pretty accurately; that piston has a hole in it, in which there is a little piece of German tinder, then force that piston down to the bottom of the cylinder. The tinder takes fire, heat is produced, but where does that heat come from? We cannot answer the question yet. When you expand a body by heat, you are an active agent. You put hot air into a gas, and the gas gets bigger; it can be made still bigger by releasing the pressure upon it. By the very process of exhausting or rarefying air, heat is absorbed, cold is produced. The rarefied air requires heat during its rarefaction, just as in heating air you make it more rarefied and make it larger. There can be no question of friction here because the air has been withdrawn from a hole in the bottom of the plate, but when air is allowed to enter through that orifice and heat is produced, then friction *may* come into play. The same effect may be better shown thus:—Take a mass of air which has been already compressed, and this made to impinge upon the face of the pile has a cooling effect. So ice can be formed and is formed. Imagine that you have a strong boiler and pump air into it; during the process of pumping it gets hot. Allow it to cool, and allow the air to expand, and it requires heat, which it takes from bodies in contact with it, such as water, and freezes them.

If, on the other hand, instead of this compressed air expanding, we take the mere mechanical rubbing of the air in motion against the surface, the same effect is obtained as in rubbing two bodies together. If I blow the bellows sufficiently strong upon the face of the pile, this very act of rubbing will warm the surface.

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* Abstract of the sixth of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 22nd ult.

This production of heat by means of friction led people to imagine that heat was mechanical motion, and we must reconcile the known phenomena, which we have been hitherto studying with this view. Heat is generally supposed not to be a distinct thing, but an agitation of the particles of matter. According to this notion, particles of matter are moving amongst one another like gnats in a swarm, or like the heavenly bodies. Imagine that this moving mass is stopped in its motion of translation from place to place; what takes place resembles that which occurs when a moving chime of bells is stopped. They do not ring while moving as a whole, but strike a body, and the bells would begin ringing. Imagine that radiant heat in passing through space to be the motion of these particles of ether, and that these particles of ether are not without momentum; but that they are capable of both receiving and imparting similar vibrations to the particles of ponderable matter. Here, however, there is a sort of divergence in the opinions of people. Some people hold (assuming the sun as the source of heat) that the heat of the sun consists of vibrations of the particles of the sun, and that this vibration is communicated to the particles of that medium called ether pervading space between the sun and the earth. I may say that almost all people hold this view; but when the radiant heat of the sun strikes transparent bodies upon the earth, then the views of different people diverge. Some suppose that the ether pervading universal space is continued throughout the most solid ponderable matter; others hold that, as soon as these vibrations meet with ponderable matter, the ether itself ceases to exist, but its motion is carried on. There is thus a very tough fact to swallow, that ether is called an imponderable substance; and, as far as one knows, there is no such thing as weight without momentum. Now, if there be any ponderable matter between the sun and the nearest point of the earth, how comes it that force is communicated? That it is communicated is apparent to us all. Go into the shade, and take, say, a well-stoppered bottle of air (the blacker the surface of the bottle is the better), just move it afterwards a foot into the sunshine, when the stopper will be blown out, and the air expelled. This force is transmitted through interstellar space which has no weight. We are accustomed to associate momentum with weight or motion. Let us study more exactly this line of argument—the relation between the mechanical manifestation of heat and heat itself. Supposing you take a hammer, and hammer a leaden bullet with it. Here is a mass of matter going downwards, and it is suddenly stopped, but no force can be annihilated. What becomes of this great momentum? It is converted from the motion of translation into heat. It is well known that bodies can be heated in this way, but the question arises, is the heat a mere accidental attribute of this stoppage of the motion of translation, or is it necessary to it, or is it proportional, and is the one converted into the other? That question has been answered in the affirmative, and in this way. A man has got a certain amount of work to do—say a hodman having to carry 1000 bricks to the top of a house. He will only be paid when the work is done, but he may carry up these bricks one at a time, or as many as he pleases. It is clear that the financial bargain is completed, and the work is done when the bricks once at the bottom are now at the top. Supposing these 1000 bricks fall to the bottom again, they will strike the bottom with a certain force. One step further—supposing that the 1000 bricks falling down are fastened by a pulley, they will be sufficient to pull 1000 bricks up; strictly speaking, a mere fly settling on the rope will disturb the equilibrium. It matters not whether these bricks fall fast or slow, just as they could be lifted one at a time or more. So if we take a mass of matter, say 1 pound weight, or a kilogramme, and lift that up from the ground to the table, that is the unit of work. The work that is done in lifting 1 kilo. 1 metre in height is stored up in the kilo., and is then called potential; and is capable, by its descent, of lifting its own weight its own height. Take a weight held by a string, and let it fall from a height upon a plate of iron; its motion is suddenly stopped, and there is a motion of translation from place to place annihilated, but represented by the vibration of the particles gradually subsiding, which we call heat. One may compare the heat of the motion to the vibration of the leaves of trees. The tree may sway to and fro, or the leaves may rustle, and there may be the same amount of work done in the rustling of the leaves as in the swaying of the tree, *i.e.*, the conversion of motion of translation into motion of vibration. It is found that, when 430 kilogrammes fall slowly through one metre, and in doing so overcome friction, the heat produced by the friction is sufficient to raise one gramme of water 1° C. This is the mechanical equivalent of heat.

If heat be this molecular vibration, many things become clear. The *intensity* of heat of a body, or its temperature, is the rate of motion of its particles amongst one another, and this is independent of their number, that is, the size of the body and also of the weight of each individual particle. Whatever be the mass or weight of a moving particle, it can never, by one or more impacts, give a greater velocity than its own to another particle. So the temperature of one body can never be raised above the temperature of the body whence it gets its heat, and hence, also, any two bodies of unlike temperature acquire the same temperature when in contact. Again, the *quantity* of heat in a body depends (1) upon the size of the body, and (2) both upon the velocity and mass of its particles, *i.e.*, on their momentum. Heat quantity, apart from size of matter, is molecular momentum. A blow with a hammer may drive a nail further into a board than the impact of a pistol ball. So there may be as much or more heat in a heavy particle moving slowly (cold) than in a lighter particle moving more rapidly (hotter). Capacity for heat is molecular inertia. Specific heat is the ratio of molecular inertia. When a body receives heat, its particles are thrown into more violent motion. Most frequently this is followed by an increase in the orbits of the particles, which results in an increase in the general size of the body. Such is expansion by heat. Sometimes, however, as with water below 4° C., the body shrinks as it gets heat, showing that the increased rate of vibration is not accompanied by increased orbit size. Conduction of heat is the spreading of molecular motion like agitation in a crowd. When heat is produced by burning, the particles of O unite with those of C, and form compound particles; the greater the attraction between the two, the closer they get together, and the more rapid is their motion, just as those planets move fastest around the sun which are nearest to it.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 8, 1873.

Reply to M. Pasteur Concerning the Origin of Beer-Yeast.—M. Trecul.

Determination of the Relation of the Two Specific Heats by Compression of a Limited Gaseous Mass.—M. Amagat.—The author operated with an improved form of the method of MM. Clement and Desormes (avoiding the phenomenon of oscillation of the gaseous mass at the orifice). A slight correction was made for lowering of temperature after compression, and the numbers got for atmospheric air were—

$$\frac{C}{c} = 1·391$$

without correction, and 1·397 with it. The mechanical equivalent of heat thence deduced was 434, which differs by only 1 unit from that recently found by M. Violle with Foucault's apparatus.

Letter from M. Poëy on the Relations between the Solar Spots, Storms at Paris and at Fécamp, and Tempests and Gales of Wind in the North Atlantic.—The storms at Paris and Fécamp coincide (in their maxima), like the hurricanes of the Antilles, with the maxima of the spots; but, in the case of North Atlantic tempests and gales, the coincidence is with the minima of spots. The writer tabulates 1067 storms at Paris in the period 1785 to 1872, and 310 at Fécamp from 1853 to 1872, also 829 Atlantic gales from 1860 to 1868. The distribution of the first-mentioned embraces 8 maximum periods of spots, of which 6 agree with the maxima of storms. Of 8 minimum periods, 5 coincide with those of the spots. The year 1810 presents a considerable maximum in place of a minimum, but it is the single strange anomaly observed in the 16 periods of storms, of which 11 correspond to periods of spots, 2 are tolerably satisfactory, while 2 are doubtful. M. Poëy compares these results with what he got for the hurricanes of the Antilles, and finds a striking agreement between the two series of phenomena—not merely in their coincidences, but in their discordances. Considering the difference of the phenomena, and that of latitude, this agreement points to cosmic influence. In the Fécamp storms, 1 maximum and 2 minima are about a year before the corresponding periods of the solar spots, and the minimum of 1867 (as in the Paris storms) is wanting. As regards the North Atlantic tempests and gales, the minimum of instances corresponds to the maximum of spots in 1860, and the maximum of instances to the minima of spots in 1867. After citing some explanatory facts mentioned by M. von Freeden, the writer arrives at the conclusion that there are in the centre of the Atlantic two systems of tempests—the one produced by predominance of the polar current, and back-flow of the equatorial current to the limit of contact between the cold waters and the hot waters of the Gulf-Stream (these are the winter and European tempests); the others inversely produced at this limit by the predominance of the equatorial current, and the back-flow of the polar current (these are the true equinoctial hurricanes which reach us from the intertropical region, starting from 10° N. lat. The relation between these two systems of cyclonic perturbations seems to consist in the fact that the predominance and energy of the polar current corresponds to the minima of the spots, while the predominance and energy of the equatorial current corresponds to the maxima of spots.

Preliminary Note on Elements Existing in the Sun.—J. N. Lockyer.

Nature of the Chemical Elements.—Observations by M. Berthelot, *apropos* of a communication from Mr. Lockyer.

Remarks by M. Dumas on the same Subject.

Observations of Falling Stars in November.—M. Wolf.—These were made at a number of different stations in France, Italy, and Portugal on Nov. 12, 13, and 14 last. Compared with preceding years, they clearly show the rapid decrease of the phenomenon, which reached its maximum of brilliancy in 1866. The retrogradation of the node of the orbit appears each year in the retardation of the phenomenon.

New Observations of the Periodic Comet of M. Faye, and Discoveries and Observations of Twenty Nebulæ, made at the Marseilles Observatory.—M. Stephan.

Movement of an Elastic Wire, One End of which is Animated with a Vibratory Movement.—M. Mercadier.—Fourth note.

Action of certain Toxical Substances on Sea Fishes.—MM. Rabuteau and Papillon.—In general, and with some interesting exceptions, organic poisons act on fishes in the same way as on species belonging to other groups of the animal kingdom. The poisons used were strychnine, morphine, thebäine, and iodide of tetramethyl-ammonium, the method being mostly that of injection.

Experiments on the Employment of Galvano-Causty in Surgical Operations.—MM. Legros and Onimus.

Observation of a Bolide at Versailles on Dec. 3, 1873.—M. Martin de Brettes.

Analysis of the Water of the Spring St. Thiébaut, Nancy.—M. P. Guyot.—This water contains per litre:—

	Grm.
Free carbonic acid	0·018
Carbonate of lime	0·310
Carbonate of iron..	0·020
Carbonate of magnesia	trace
Sulphate of lime	0·350
Sulphate of magnesia..	0·015
Chloride of sodium	0·059
Chloride of potassium..	traces
Sesquioxide of iron	0·020
Silica and alumina	0·010
Arseniate of iron..	traces
Fluorine	
Crenic and apocrenic acids ..	

Certain Combustibles of the Basins of Donetz and Toula, Russia.—A. Scheurer-Kestner and Ch. Meunier-Dollfus.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 17, November 24, 1873.

On Chlorobrom-Aceton.—Albert Theigarten.—This body forms well-defined crystals of pungent odour, sparingly soluble in water, but readily in alcohol and ether. It melts at 34° to 35·5°, and congeals again at 24°. Its boiling-point is 177° to 180°. Its formula is $CH_2BrCOCH_2Cl$.

Uramidic Acids.—H. Huppert.—A theoretical, or rather hypothetical, paper.

On Santonic Acid.—O. Hesse.—Heldt's saline compounds are true salts of an acid, $C_{15}H_{20}O_4$, which, in the anhydrous state, is known as santonin. Santonic acid forms white rhombic crystals, which do not turn yellow on exposure to light. It is sparingly soluble in cold, more readily in hot, water, from which it crystallises on cooling.

Reply to the Remarks of Herr Oudemans, jun., on the Molecular Power of Deflection of Tartaric Acid and its Salts.—H. Landolt.—A controversial paper, with reference to the *Berichte*, heft 14, p. 1073, and heft 15, p. 1166.

Preliminary Communication on Cholic Acid.—H. Tappeiner.—A history of the author's researches on cholic acid and its compounds.

Platinochloride of Glucinum.—A. Welkow.—This compound is formed on mixing concentrated solutions of the two chlorides, and can be obtained in yellow hygroscopic crystals, deliquescent in moist air. If heated to 100°, there is loss of water; from 100° to 150°, there is no change; but, above 150°, water again escapes, and the compound is destroyed. This substance consists of $GPtCl_6+8H_2O$, assuming $G = 9·4$. The crystals are easily soluble in water and alcohol, but insoluble in ether.

Derivatives of Glycerin.—Ernst Brackebusch.—On distilling iodide of allyl with nitrite of silver, the author obtained the trinitro-derivative of glyceryl, from which, again, triamido-glyceryl was produced.

Formation of Metallic Sulphides by means of Ammoniacal and Alkaline Sulphides.—E. Priwoznik.—This paper relates in great part to certain researches of

Heumann on the same subject, which appeared in the *Transactions* of the Vienna Academy of Sciences (vol. lxv., sect. ii., 1872). Solution of pentasulphide of sodium assumes a dark brown colour on contact with the oxide and the oxide of copper, and gives up a considerable quantity of sulphide of copper in contact with hydrochloric acid. Oxide and peroxide of lead, in contact with sulphide of ammonium, are converted into sulphide of lead, of a crystalline texture. Oxide of cadmium, whether blue-black or brown, yield, with polysulphides of ammonium, sulphide of cadmium; the transformation is very slow. Oxide of manganese, on heating for twelve hours in the water-bath with sulphide of ammonium, yields flesh-coloured sulphide of manganese. Hydrated peroxide of manganese, on treatment with sulphide of ammonium, disengages heat, and passes into sulphide of manganese. Oxide of iron undergoes no change.

Nature of the Elements.—J. A. Groshans.—This paper does not admit of abstraction.

Sensibility of Bromide of Silver to Light, as regards the so-called Chemically-Inactive Colours.—Herm. Vogel.—The author remarks that bromide of silver is sensitive to rays of light which have hitherto been darkness for photography. He finds that the bromide when dry is more sensitive for the less refrangible rays, but when moist far the more refrangible rays of the visible spectrum. He considers it practicable to make bromide of silver sensitive for any desired ray of light.

Phenol-Trisulphuric Acid and certain New Derivatives from Oxysulpho-Benzid.—J. Annaheim.—This paper is not suitable for abstraction.

Determination of Methylic Alcohol in Commercial Wood-Spirit.—G. Krell.—The author finds that the conversion of wood-spirit into iodide of methyl is the best means of determining its percentage of methylic alcohol. Into a glass flask, containing about 100 grms., 30 grms. of dry biniodide of phosphorus (PI_2) are put, and closed with a stopper, preferably of glass, perforated with two holes. One of the apertures contains a pipette, holding about 5 c.c., and the other supports a tube bent at an obtuse angle. The latter is fitted with a good cooling apparatus, and serves first as a cohobator, and afterwards as a condenser, the flask being gently inclined. The pipette is filled with exactly 5 c.c. of the wood-spirit in question at 15° C., and allowed to flow down upon the iodide of phosphorus gradually—ten drops per minute. When all has been added, the flask is heated for five minutes with boiling water, during which the cooling apparatus serves as a cohobator. The apparatus is then set in a slanting position, so that the distillate may flow off, and distilled at a water-bath heat as long as anything passes over. Towards the end of the process, the flask must be entirely submerged in boiling water. The distillate is collected in a glass receiver, which is best made of a tube narrow below and accurately graduated. The receiver holds 25 c.c., and when the distillation is ended it is filled up with water to the mark 25 c.c., the condensing tube being rinsed out with a part of the water. If transparent crystals of iodide of phosphonium are formed in the condensing tube, the water for rinsing must be added very gradually. The iodide of methyl in the receiver is shaken up with the water, and its volume read off at 15° C. 5 c.c. of chemically pure methylic alcohol yielded 7·19 of iodide of methyl.

Formula of Tauro-Carbaminic Acid.—E. Salkowski.—The author announces that the formula given for this acid in his former communication is not correct.

Liebig's Annalen der Chemie und Pharmacie.
October 24, 1873.

Decomposition of Nitric Acid by Means of Heat.—L. Carius.—A lengthy paper, not suitable for abstraction.

Chlorides of Molybdenum.—Dr. L. P. Liechti and Bernhard Kempe.—The pentachloride, $MoCl_5$, was considered by Berzelius as $MoCl_4$. It is a black body, which, after fusion, takes a radiating crystalline form. It melts at a gentle heat, and sublimes unchanged in a current of chlorine. If it has a greenish reflection, a trace of oxychloride has been formed. If heated in the air, it is decomposed, yielding a white oxychloride, MoO_2Cl_2. If exposed to the air it deliquesces, becoming a bluish-green, and finally yielding a brown liquid. If drenched with a little water it becomes a brown solution, the change being accompanied by a hissing noise. With a little absolute alcohol it dissolves to a rich deep green liquid. The terchloride, $MoCl_3$, is formed by heating the foregoing gently in a stream of hydrogen. It is a dark brown amorphous powder, insoluble in, and not attacked by, cold water. The quadrichloride, $MoCl_4$, is formed by heating the terchloride in an atmosphere of carbonic acid. It evaporates as an intense yellow vapour, leaving the bichloride, $MoCl_2$, behind as a dull yellow powder.

Atomic Weight of Molybdenum.—Lothar Meyer.—The author's results are 95·70 to 95·66, which, of course, are to be halved, if O is assumed = 8.

Brown Oxide of Chromium.—E. Hintz.—The author finds that it is a very indifferent body. Whether it is to be considered as a simple peroxide, CrO_2, or as a basic chromate of chromic oxide, $Cr_2O_3CrO_3$, he does not decide.

Sulpho-Ortho-Toluidinic Acid.—F. Gerver.—The author gives this acid the formula $C_7H_6NH_2SO_3H,H_2O$. He examines its potash, soda, baryta, lead, and silver salts; also the products of its decomposition by bromine tribrom-orthotoluidin, $C_7H_6Br_3N$; dibrom-sulpho-orthotoludinic acid, $C_7H_4Br_2NH_2SO_3H,H_2O$, with its baryta, lead, and silver salts; the diazo compound, $C_7H_6N_2SO_3$; sulphotoluolic acid, $C_7H_7SO_3H$; the amid, $C_7H_7SO_2NH_2$; sulphobrom-toluolic acid, $C_7H_6BrSO_3H$, with its baryta, lead, potassium, and sodium salts; the chloride, non-crystalline; the amide, $C_7H_6BrSO_2NH_2$; sulphocresolic acid, C_7H_7O,SO_3H, with its lead and baryta salts.

Specific Heat of Zirconium, Silicium, and Boron.—W. G. Mixter and E. S. Dana.—For silicium, the authors find 0·1710; for zirconium, 0·6666; and for boron, 0·2518.

Revue Scientifique de la France et de l'Etranger,
No. 22, November 29, 1873.

The Vinegar Polype.—A very singular present has been made to the aquarium of the Society of Acclimatisation at Paris. It is a polype of the *Medusa* tribe, which the next morning after it had been placed in one of the tanks was found to have skilfully got rid of the neighbours which had surrounded it. On analysis, the water of the tank was found converted into vinegar. Hence the new-comer was evidently one of that rare species the vinegar polype, which, when placed in pure water, produces first alcohol, and afterwards vinegar.

Revue Hebdomadaire de Chimie Scientifique et Industrielle,
par Ch. Mène, No. 42, 1873.

Chemical Procedures for the Destruction of the Phylloxera and other Parasites Infesting the Vine.—Chatelain's "apathophyte" is a secret remedy, apparently formed by boiling vulcanised caoutchouc with an alkali. Perron's specific is merely sulphate of copper dissolved and mixed with sawdust, ashes, &c. Fichet's remedy is an alkaline solution of coal-tar.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 252, December, 1873.

This number contains no chemical matter.

NOTES AND QUERIES.

Grinding Machine.—Can any one inform me where, and at what cost, I can obtain any hand machine for grinding up minerals?—Marshall Hall.

THE CHEMICAL NEWS.

Vol. XXIX. No. 740.

ON THE BROM-IODIDES.*

By Dr. MAXWELL SIMPSON, F.R.S.,
Professor of Chemistry, Queen's College, Cork.

Some years ago I ascertained that chloride of iodine combines directly with the olefines and the non-saturated haloid ethers in the same manner as free chlorine or bromine. I have since ascertained that bromide of iodine also enters into direct combination with these bodies.

In the following experiments I have invariably used a solution of bromide of iodine in water, which was prepared by adding rather more than a molecule of iodine in fine powder to a molecule of bromine previously mixed with about six times its weight of water. The bromine was repeatedly agitated during the addition of the iodine, and kept cold by being surrounded by water. An almost black liquid was thus obtained, which was separated from the excess of iodine.

Brom-Iodide of Ethylen.—This body was formed by passing a stream of olefiant gas into the foregoing solution, which was kept cold during the absorption of the gas. An oily liquid soon made its appearance, which was the body in question; it was then subjected to distillation, having been previously washed with dilute potash, and afterwards with distilled water. Almost the entire quantity passed over without decomposition between 162° and 167° C. This gave on analysis the following numbers:—

	C_2H_4BrI. Theory.	Experiment.
C	10·21	10·35
H	1·70	1·79

At the temperature of the air this is a solid body, consisting of a mass of long white needles, which melt at 28° C. At 29° it has a specific gravity = 2·516. It has a sweet biting taste; on exposure to light it becomes slightly coloured, from the separation of free iodine. When subjected to the action of alcoholic potash, it yields iodide of potassium and a gas burning with a green flame, which is doubtless bromide of vinyl. It is an isomer of the brom-iodide obtained by Pfaundler,† and afterwards by Reboul,‡ by exposing bromide of vinyl to the action of hydriodic acid. Pfaundler's compound boils between 144° and 147° C.

Brom-Iodide of Propylen.—This body was formed by passing propylen-gas derived from iodide of allyl into the brom-iodine solution. It was washed with dilute potash, then with water, and distilled. The greater part passed over between 160° and 168° C., suffering, however, at the same time, slight decomposition. The distillate was then analysed, having been previously agitated with mercury to remove free iodine. The following are the results:—

	C_3H_6BrI. Theory.	Experiment.
C	14·46	14·89
H	2·41	2·77

Notwithstanding the difference between the theoretical and experimental numbers, I believe this is a definite compound, and not a mixture of bromide and iodide of propylen. The discrepancy probably arises from the slight decomposition which the body suffered during distillation.

Brom-iodide of propylen is, when freshly prepared, a colourless oily liquid; it has a sweet and biting taste. Treated with alcoholic potash, it yields iodide of potassium and brom-propylen (C_3H_5Br).

Iodo-Dibrom-Vinyl.—When the brom-iodine solution and bromide of vinyl are brought into contact, direct combination takes place, and this body is formed. In order to complete their union, it is advisable to heat them gently in a sealed tube. A portion of the oily product thus obtained was washed with potash and distilled; almost the entire quantity passed over between 170° and 180° C. As, however, it suffered considerable decomposition during distillation, I analysed, in preference, a portion of the remainder, which had *not* been distilled, having previously dried it at 100°, and agitated it with metallic mercury to remove a trace of free iodine. The following are the results of the analysis:—

	$C_2H_3Br_2I$. Theory.	Experiment.
C	7·64	7·67
H	0·96	1·11

This is a colourless oily liquid; like the others it has a sweet and biting taste. Its specific gravity at 29° C. is 2·86. Heated to the temperature of 100° in a sealed tube with moist oxide of silver, it occasioned a violent explosion. Heated in an open retort with the same body, it evolved carbonic acid gas and bromide of vinyl.

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* A Paper read before the Royal Society.

† *Jahresberichte*, 1865, p. 483.

‡ *Ibid.*, 1870, p. 439.

CONTRIBUTIONS TO THE HISTORY OF THE ORCINS.

No. IV. ON THE IODO-DERIVATIVES OF THE ORCINS.*

By JOHN STENHOUSE, LL.D., F.R.S., &c.

A preliminary notice on these compounds has already appeared in the Chemical News, vol. xxvi., 279, and the present paper contains a more detailed account of my experiments.

In 1864† I published an account of a crystalline teriodorcin obtained by precipitating an aqueous solution of orcin with a solution of iodine monochloride, but I found I was unable to prepare any other iodine derivative of orcin by this process. It seems probable, however, that the method devised some years ago by Prof. Hlasiwetz,‡ and communicated by him at the meeting of the Naturforscher und Aerzte in Innsbruck, would yield the lower substitution compounds. This was found to be the case; for on agitating an ethereal solution containing equal molecular weights of orcin and iodine with dry precipitated mercuric oxide, the colour rapidly disappears, and monoiodorcin is formed; this may be obtained by distilling off the ether and crystallising the residue from benzol, in order to separate an uncrystallisable oily compound which accompanies it. It is, however, still contaminated with a small quantity of mercuric iodide, which obstinately adheres to the substance, and can only be removed by re-crystallisation from a dilute aqueous solution of potassium iodide; this difficulty arises from the circumstance that mercuric iodide is more or less soluble in most of the liquids usually employed as solvents. For this reason I found it advisable to substitute plumbic oxide for the corresponding mercury compound originally proposed by Hlasiwetz.

Monoiodorcin, $C_7H_7IO_2$.—1 part of pure dry orcin is dissolved in 6 parts of ether, then 2 parts of iodine are added, and the mixture agitated until the whole of the iodine is dissolved; 9 parts of very finely powdered lead oxide (litharge) are now introduced in small portions at a time with frequent agitation. A marked action takes place, accompanied by development of heat, and the colour of the solution rapidly disappears. On distilling off the ether, and extracting the residue with hot benzol, the iodorcin separates in the crystalline state on cooling. Two or three alternate crystallisations from benzol and from water suffice to render the compound pure; but care must be taken not to boil the aqueous solution for any length of time, as the iodorcin is thereby partially decomposed.

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* A Paper read before the Royal Society.

† *Journ. Chem. Soc.*, vol. xvii., p. 137.

‡ *Deut. Chem. Ges. Ber.*, iii., 558.

Monoiodorcin in a pure state crystallises in colourless prisms, which melt at 86·5°, and decompose with evolution of violet vapours of iodine when strongly heated. Concentrated sulphuric acid has but little action on the substance in the cold: but when gently heated with it the iodorcin is decomposed and iodine is freely liberated. Warm nitric acid likewise acts energetically, evolving nitrous fumes and liberating iodine. Iodorcin is only slightly soluble in cold water, but readily in hot water. It is very soluble in ether and in hot alcohol; moderately so in benzol and in hot petroleum, crystallising out from the latter almost entirely on cooling; slightly soluble in carbonic disulphide. It is quite destitute of the peculiar astringent sweet taste so characteristic of pure orcin.

Dried *in vacuo*, and submitted to analysis, it gave the following results:—

I. 0·332 grm. substance gave 0·311 grm. argentic iodide.

II. 0·256 grm. substance gave 0·314 grm. carbonic anhydride and 0·067 grm. water.

		Theory.	I.	II.
C_7	= 84	33·60	—	33·44
H_7	= 7	2·80	—	2·90
I	= 127	50·80	50·63	—
O_2	= 32	12·80	—	—
	250	100·00		

These numbers correspond with those required by the formula $C_7H_7IO_2$.

Monoiodresorcin, $C_6H_5IO_2$.—This compound is prepared in a manner similar to the corresponding orcin compound; 10 parts of resorcin and 24 of iodine are dissolved in 60 of ether, and about 110 of lead oxide are gradually added. After removal of the ether and extraction with benzol, the iodorcin is purified by crystallisation from hot water, in which it is much more soluble than the iodorcin. Iodresorcin crystallises in rhomboidal prisms, which are very difficult to obtain colourless; they melt at 67°, and, like those of the orcin derivatives, decompose when strongly heated. It is much more soluble in water than iodorcin, and is very soluble in alcohol or ether; hot benzol dissolves it readily, but it is only slightly soluble in carbonic disulphide. When heated with nitric or sulphuric acid it behaves like iodorcin.

The analytical results were obtained from the compound dried *in vacuo* at the ordinary temperature.

I. 0·343 grm. substance gave 0·341 grm. argentic iodide.

II. 0·357 grm. substance gave 0·354 grm. argentic iodide.

III. 0·265 grm. substance gave 0·298 grm. carbonic anhydride, and 0·053 grm. water.

		Theory.	I.	II.	III.
C_6	= 72	30·51	—	—	30·67
H_5	= 5	2·12	—	—	2·22
I	= 127	53·81	53·73	53·58	—
O_2	= 32	13·56	—	—	—
	236	100·00			

The numbers agree with the formula $C_6H_5IO_2$.

In preparing teriodorcin by the action of iodine protochloride on orcin, it was observed that a comparatively large amount of the dilute solution of iodine chloride could be added to the aqueous solution of orcin before a permanent precipitate of teriodorcin was produced. It seemed possible that an intermediate iodine derivative was first formed, far more soluble than the teriodorcin, and which subsequently became converted into the latter by the further action of the chloride of iodine. In order to ascertain whether this was actually the case, a dilute solution of iodine protochloride was added to an aqueous solution of orcin, containing 1 part of orcin in 50 of water, as long as the precipitate re-dissolved in the liquid on agitation. The addition of iodine was then stopped, and the filtered solution agitated with ether. The ethereal solution, on evaporation, left an oily uncrystallisable liquid which was readily soluble in water, and which evolved iodine when heated with concentrated sulphuric acid: this liquid, on standing some days, deposited a few crystals of unaltered orcin.

I cannot conclude this paper without acknowledging the very efficient aid I have received from my assistant, Mr. Charles Edward Groves, in conducting this investigation.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 30).

The Glass.

The flasks and vessels used were of the hardest Bohemian glass, and as thin as they could be employed. When practicable, vessels of old green German glass were used; neither this nor Bohemian glass is practically affected by reagents.

Liquids were generally kept sealed up in glass bulbs and globes, but sometimes in stoppered green German glass flasks or in "bromine" bottles. When liquids were kept in these bottles for a few days only, they were not found to have contracted any saline impurity from the glass, but after remaining for some weeks they were found to leave a visible residue on evaporation.

No cork or luting was employed in the distillations, &c.; in most cases the apparatus was blown in one piece, and the operations performed in a vacuum. The pieces of apparatus which were weighed were entirely composed of glass suspended with platinum loops. The fingers were not allowed to touch them after the first weighing.

The weight of tubes, bulbs, and flasks, even of hard Bohemian glass, constantly diminishes when the glass is long heated in a spirit- or gas-flame; this loss may amount to several thousandths of a grain in the space of two hours when a bulb of Bohemian glass 3 inches in diameter is exposed to a decided red heat in a gas-flame. Following the suggestion of Professor Stas, I have obviated this source of error by employing a bath of pure magnesia; and find that the weight remains constant even at a nearly white heat. Baths of lime have sometimes been employed with similar satisfactory results.

The special apparatus that I have used will be described in the processes in which they were required; I need scarcely say that in no case were materials of untried purity employed.

Improved Sprengel Vacuum-Pump.

[Before detailing the processes of the determination, it will be requisite to describe the means of producing a vacuum in the flasks and bulbs employed. In proceeding with the determinations, several additions and improvements have been made to the Sprengel pump as generally found in the laboratory. Working so much with this pump, I have endeavoured to avoid the inconveniences attending the usual mode of raising the mercury from the lower to the upper reservoir.

The mercury is contained in a closed glass reservoir A (Fig. 2), perforated with a fine hole at the top. This reservoir is attached to a block, capable of free movement in a vertical line, and running in grooves, and connected with the lower reservoir by a flexible tube, *g*.

When the whole of the mercury has run from the reservoir, A, the reservoir and slide can be lowered by liberating the teeth of the cog-wheel, K, from the detent, *m*; at the same time a friction-brake is pressed against the cylinder. The aim of this arrangement is to permit the slide-block to fall steadily, swiftly, and without any injurious shock upon the block, L. H is a glass reservoir, which receives

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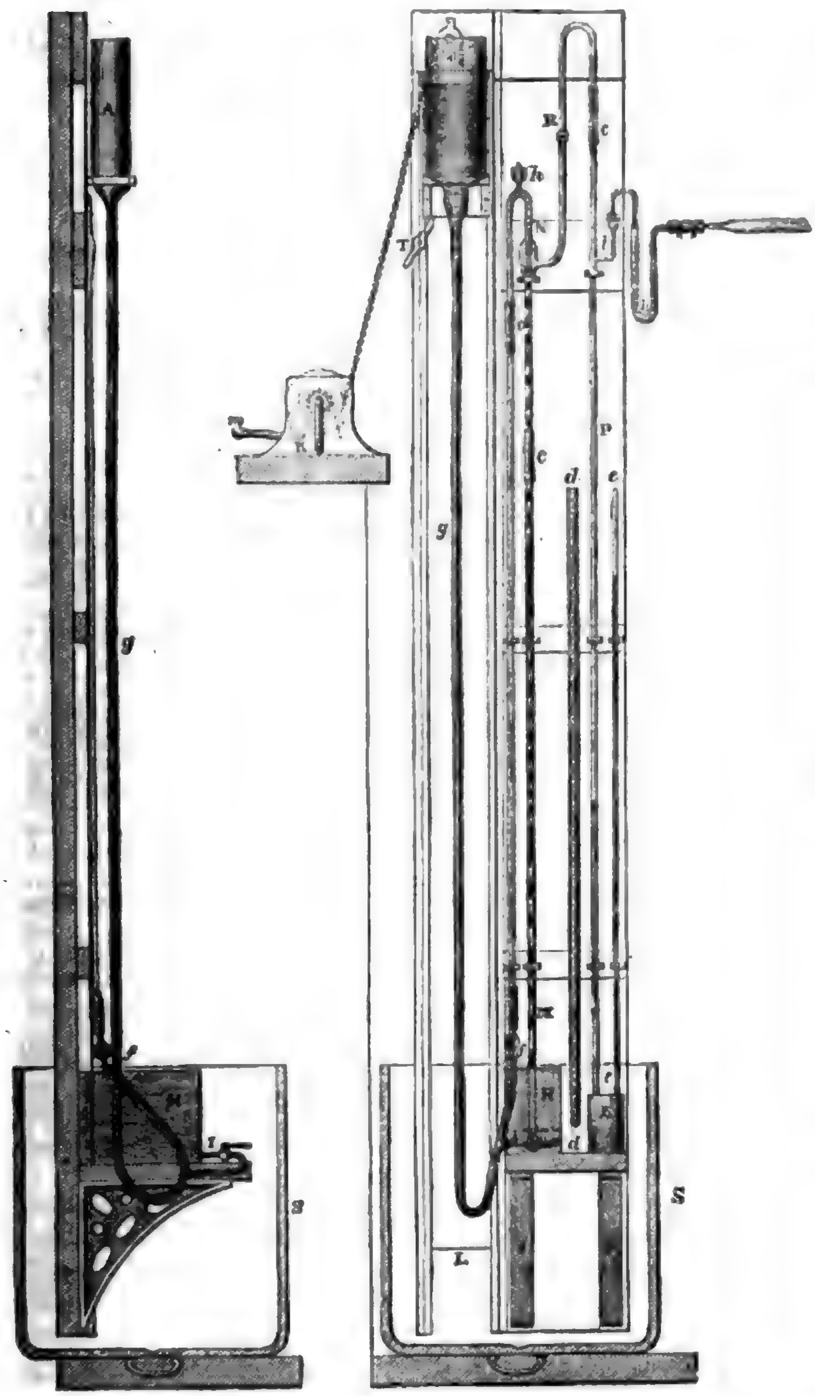
[*] A Paper read before the Royal Society June 20, 1872.

the mercury after flowing through the pump. When the reservoir, A, is emptied and has been lowered to the block, L, the mercury from H is admitted into A by opening the tap, I. *f* is another tap, to regulate the flow of mercury through the pump, whilst a third tap is at R. *g* is a flexible india-rubber tube, strengthened to withstand the pressure by being constructed of concentric layers of rubber and canvas. *b* is a tube filled with small glass beads, and containing concentrated sulphuric acid to absorb moisture;* it is attached to *l* by means of a mercury joint. *c*, *c*, *c* are mercury joints, it being inconvenient to have the apparatus in one piece of glass tubing. *e e* is a barometer dipping into the same vessel as the gauge-barometer, P, the two thus forming a differential system, by which the rarity of the atmosphere in the apparatus to be exhausted can be easily estimated. *d d* is a scale attached to the gauge.

FIG. 2*a*. FIG. 2.



The reservoir, A, being filled with mercury, the tap, I, is turned off, and the reservoir is raised to the top of the slide, where it is supported by the piece, T.

On opening the tap, *f*, the mercury rises in the tube, *f h*, and falling through the chamber, N, carries with it the air contained in the tube, R, and in the apparatus or bulbs attached to the tube, *b*, as in the ordinary Sprengel pump. At N the tubing is enlarged, in order that the mercury may not be forced up the tube, R, as otherwise frequently happens if the apparatus or mercury gets soiled. This liability of the mercury to run up is further obviated by raising the tube, R, above the level of the upper reservoir, A.

J, J are iron brackets supporting the apparatus. S is a large inverted glass receiver to collect the small portions of mercury which are unavoidably and constantly being spilled; it contains a little weak solution of carbonate of sodium. The part of the tubing, *g f h* N, forms a barometric syphon arrangement, which effectually prevents air getting into the enlargement, N, from the reservoir, A, when the mercury has completely run out; in this case no harm whatever is done to the operation, the vacuum is not injured, and the exhaustion proceeds immediately on re-transferring the mercury from the reservoir H, to the reservoir A, and raising A again into its place. The apparatus, as thus arranged, is readily manageable, with certainty of obtaining a barometric vacuum.

The mercury fall-tube of a pump in constant use frequently wants cleaning. I find the most effectual means of doing this is to put oil of vitriol into the funnel stopper, *h*, and then, by slightly loosening the glass stopper, allow a little of the strong acid to be carried down the tube with the mercury. With care this can be effected without interfering with the progress of exhaustion. The residual acid in the chamber, N, does good rather than harm. When sufficient sulphuric acid has run into the fall-tube, the funnel stopper can be perfectly closed by filling it with mercury.

The preceding description is that of the apparatus with the most recent improvements. During the determination of the atomic weight of thallium a pump was employed similar in detail, with the exception that, instead of the movable reservoir and flexible rubber tubing, a glass funnel with tubing of glass was used. The mercury passing from the funnel was broken up in its fall, and freed from adhering air-bubbles by the insertion of two silk-covered thin iron wires extending from the funnel to the base of the tube. As equally perfect results can be obtained by both methods, the details should be considered as improvements for the sake of convenience rather than for accuracy. —November 29, 1872.]

Detection of Acetic Acid in Wines.—M. Kissel.—In separating acetic acid from wines by distillation, the acid may escape undetected, because it forms acetic ether with the alcohol. This inconvenience may be avoided by saturating the wine with baryta. The alcohol is then distilled off, and phosphoric acid added to the residue. On distilling again, the acetic acid is found in the distillate, and may be determined.

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* Since writing the above description I have soldered a small glass tube to the lower part of *b*, turned up and terminating in a funnel-shaped mercury stopper. This enables me to draw off the old acid when weakened by absorption of moisture and to replace it by fresh acid, and also to pass different gases into any apparatus I may have under experiment.—W. C., July, 1873.

THE CHEMICAL CONSTITUTION OF CITRIC ACID AND ITS NUMEROUS DERIVATIVES,

CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Continued from page 43).

THE following cases have been chosen for analysis with the view of comparing the chemical formulæ thus arrived at with those embodied in the foregoing schemes.

The first case refers to the artificial production of the ordinary pyrotartrate, which, according to Simpson, is obtained by decomposing the dicyanide of propylen with hydrate of potash. A simple enumeration of the chief transition products will, I trust, enable the reader to comprehend the *rationale* of a process so closely analogous to the decomposition of the dicyanide of ethylen under similar circumstances. Commencing with the dicyanide—

$$\begin{array}{ll} & \qquad\qquad\qquad 2C_2N. \qquad\quad 2C_2N. \\ \alpha) & \overline{2(H_4C_2 : C_2) ; H_2N_2 - 2C_2 ; H_2N_2}, \\ \beta) & \quad 2H_4C_4 ; \end{array}$$

the first transition product will be the monobasic water-salt—

$$\begin{array}{ll} & \qquad\qquad 2C_2N. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2N_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O}, \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

and the second will be the bibasic meta water-salt—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3}. \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

which is thus shown to be identical with the *a* meta-erythrite of the first scheme. By the loss of 2 mols. of water, this compound is then finally made to pass into the ortho-pyrotartrate—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad\qquad H_2O_2.\ H_2O_2.\ \ H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2O_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O}, \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

which answers to the *b* ortho-erythrite of the first scheme (compare also its production from the pyruvate, Part II. of the first paper). The second case refers to the artificial production of the ortho- and iso-pyrotartrates, which, according to Wislicenus, are formed side by side on heating the mixture containing the two varieties of cyanbutyrate with hydrate of potash. In order to account for the appearance of two varieties of pyrotartrate, where only one of them is anticipated by theory, I proceed upon the hypothesis that, under the influence of the cyanide of potassium, the brom-butyrate—

$$\begin{array}{ll} & \qquad\qquad\qquad\qquad H_2O_2. \\ \alpha) & \overline{2(H_6C_4 : C_2Br) ; 2C_2O_3}, \\ \beta) & \quad 2(H_6C_6Br ; \end{array}$$

which forms the basis of this experiment, becomes transformed first of all into the isobrom-butolactate—

$$\begin{array}{ll} & \qquad\qquad\qquad\qquad\qquad H_2O_2. \\ \alpha) & \overline{2(H_4C_4 : C_2) ; H_2Br_2 : 2H ; 2C_2O_3} ; \\ \beta) & \quad 2H_4C_6 ; \end{array}$$

but the greater portion of this compound is soon made to experience a second metamorphosis, in virtue of which it passes into the brom-butolactate—

$$\begin{array}{ll} & \qquad\qquad\qquad\qquad H_2O_2. \qquad\quad H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2Br_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O}. \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

Hence the two varieties of cyan- and isocyan-butyrate, which are due to the action of cyanide of potassium on these two varieties of brom-butyrate, will be expressed by the formulæ—

$$\begin{array}{ll} & \qquad\qquad 2C_2N. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2N_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O} \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

and—

$$\begin{array}{ll} & \qquad\qquad\qquad 2C_2N. \qquad\quad H_2O_2. \\ \alpha) & \overline{2(H_4C_4 : C_2) ; H_2N_2 : 2H ; 2C_2O_3}. \\ \beta) & \quad 2H_4C_6 ; \end{array}$$

It is scarcely necessary to add, that the products resulting from the action of the hydrate of potash on these two isomerides must be, in the first instance, the two bibasic meta water-salts—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3} \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

and—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\qquad H_2O_2. \\ \alpha) & \overline{2(H_4C_4 : C_2) ; H_2O_2 : 2H ; 2C_2O_3 - 2H ; 2C_2O_3}, \\ \beta) & \quad 2H_4C_6 ; \end{array}$$

and, in the second instance, the ortho- and iso-pyrotartrates—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad\qquad H_2O_2.\ H_2O_2.\ \ H_2O_2. \\ \alpha) & \overline{2(H_2C_2 : C_2) ; H_2O_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O} \\ \beta) & \quad 2H_2C_4 ; \end{array}$$

and—

$$\begin{array}{ll} & \qquad\qquad\qquad H_2O_2.\ H_2O_2.\ H_2O_2. \\ \alpha) & \overline{2(H_4C_4 : C_2) ; H_2O_2 : 2C_2O - 2C_2O_3}, \\ \beta) & \quad 2H_4C_6 ; \end{array}$$

which are thus shown to be genetically related to each other in the same manner as the ortho- and iso-succinates. The third case refers to the artificial production of the oxy-pyrotartrate, which, according to Simpson, is obtained by boiling dicyanhydrin with potash-lye; and the fourth case refers to the artificial production of the carballylate, which, according to the same observer, may be got by subjecting tricyanide of allyl to similar treatment. Considering the striking resemblance of these two cases to each other, and to several cases that have already been discussed in full, I shall again content myself with a simple mention of their chief transition products. Commencing with the dicyanhydrin—

$$\begin{array}{c} 2C_2N. \qquad\quad 2C_2N. \qquad\quad H_2O_2. \\ \overline{2H_2C_2 ; H_2N_2 - 2C_2 ; H_2N_2 - 2C_2 ; H_2O_2}, \end{array}$$

the first transition product will be the monobasic water-salt—

$$\begin{array}{c} 2C_2N. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \overline{2C_2 ; H_2N_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O}, \end{array}$$

and the second will be the bibasic meta water-salt—

$$\begin{array}{c} H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \\ 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3, \end{array}$$

which is thus shown to be identical with the *a* meta-citraconite of the second scheme. By the loss of 2 mols. of water, &c., this compound becomes then finally transformed into the oxy-pyrotartrate—

$$\begin{array}{c} H_2O_2. \qquad H_2O_2. \qquad\quad H_2O_2.\ H_2O_2.\ \ H_2O_2. \\ \overline{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O}, \end{array}$$

which tallies completely with the *b* ortho-citraconite of the second scheme. Commencing again with the tricyanide of allyl—

$$\begin{array}{c} 2C_2N. \qquad\quad 2C_2N. \qquad\quad 2C_2N. \\ \overline{2H_2C_2 ; H_2N_2 - 2C_2 ; H_2N_2 - 2C_2 ; H_2N_2}, \end{array}$$

we have, for the first transition product, the monobasic water-salt—

$$\begin{array}{c} 2C_2N. \qquad\quad 2C_2N. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \overline{2C_2 ; H_2N_2 - 2C_2 ; H_2N_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O}, \end{array}$$

for the second, the bibasic meta water-salt—

$$\begin{array}{c} 2C_2N. \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \\ \overline{2C_2 ; H_2N_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3}, \end{array}$$

and for the third, the tribasic meta water-salt—

$$\begin{array}{l} H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \overline{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H} ; \\ \qquad\qquad\qquad\qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \\ \qquad\qquad\qquad\qquad [illegible]\ 2H ; 2C_2O \end{array}$$

which is thus shown to be identical with the meta-citréite of the third scheme. By the loss of one pair of water molecules, this compound is then changed, first of all into the tribasic ortho water-salt—

$$\begin{array}{l} \quad H_2O_2. \qquad\qquad H_2O_2. \qquad\qquad H_2O_2. \\ \hline 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : \end{array}$$

$$\begin{array}{r} H_2O_2. \quad H_2O_2. \quad H_2O_2. \\ \hline 2H ; 2C_2O - 2C_2O - 2C_2O_3, \end{array}$$

which is the same as the *a* ortho-citréite of the third scheme, and thence, by the loss of a second pair of water molecules, into the carballylate—

$$\begin{array}{ll} & \qquad H_2O_2. \qquad\quad H_2O_2. \qquad\quad H_2O_2. \;\; H_2O_2. \;\; H_2O_2. \\ \cline{2-2} \alpha) & 2(C_2 : C_2) ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O - 2C_2O - 2C_2O_3, \\ \beta) & \quad 2C_4 ; \end{array}$$

which answers to the *b* ortho-citréite of the third scheme, and may be regarded as the next lower heterologue of the ordinary, or ortho-citrate of water (the *b* ortho-citrate of the third scheme).

I shall now, in the second part, proceed to discuss a series of questions fully as interesting and portentous as those for which I have just endeavoured to find the proper treatment and solution.

(To be continued.)

THE ESTIMATION OF SILICON, GRAPHITE, MANGANESE, ALUMINIUM, AND CALCIUM IN PIG-IRONS, &c.

By CHARLES H. PIESSE,
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In *Engineering*, Nos. 108, 109, also Chem. News, xvii., 100, there appeared a process by Professor Eggertz, translated from the Swedish, by Mr. P. C. Sandberg, for the estimation of silicon and graphite in pig-irons, from which, with modifications, the following is largely drawn:—

A. *Silicon and Graphite.*

Place into a beaker of about 200 c.c. capacity 25 c.c. of cold dilute sulphuric acid (a mixture of 1 part of pure concentrated H_2SO_4 with 5 of distilled water), and shake into it an accurately weighed quantity of about 2 grms. of the powdered pig-iron. Quickly cover the beaker with a watch-glass, and boil the liquid for half an hour; then partially remove the watch-glass, so that the liquid may evaporate till it reaches about two-thirds of its original bulk. Allow the beaker and contents to cool to about 120° F., and then pour in 4 c.c. of HNO_3, sp. gr. 1·20, and again boil for a quarter of an hour. Evaporate the contents of the beaker to dryness at 212° F. This is most conveniently done by fitting the beaker into a ring of a water-bath so that it may sink about three-fourths of its height into the boiling water. The drying proceeds rapidly, and is materially hastened by occasional stirring with a glass rod, conveniently left in the beaker for that purpose. By way of finishing the evaporation, the beaker may at last be put into a water-oven for a short time. When the mass in the beaker is dry, pour upon it 35 c.c. of dilute HCl (HCl, sp. gr. 1·16, 1 part; distilled water, 6 parts); boil for a quarter of an hour. Should anything but silica and graphite remain undissolved (which will be indicated by the solution being turbid), add 2 or 3 drops of concentrated HCl. Throw the silica and graphite on to a weighed filter, and wash with cold distilled water, until a few drops of the filtrate separately collected for that purpose give no iron reaction when tested with K_4FeCy_6. Keep the bulk of this filtrate for the estimation of manganese and aluminium.

Continue the washing of the mixed silica and graphite with boiling distilled water containing 5 per cent of HNO_3. When no iron is discovered in this filtrate, recur to simple boiling distilled water until all the HNO_3 is judged to be removed; then dry the silicon and graphite at 212° F., and weigh till constant.

Transfer the dried silica and graphite to a weighed porcelain or platinum crucible, incinerate the filter-paper, and place the ash into the crucible; then ignite this until all the graphite is burnt, which is effected in two or three minutes in a muffle; cool the crucible in a desiccator, and again weigh it.

Silica, dried at 212° F., retains 6 per cent of water; therefore to obtain the results the following calculations are involved:—

Calculate 6 per cent of the weight of the ignited silica found, and subtract that amount from the loss on ignition before calculating the loss on ignition as graphite.

Calculate the ignited silica found into silicon. Perhaps the example from practice given below may make this explanation clear.

Iron employed	1·9998
Watch-glasses + filter-paper + residue ..	19·7838
" " only ..	19·5800
Residue (mixed SiO_2 + Gr)	0·2038
Crucible + residue + ash of filter-paper	18·28500
" + ignited SiO_2 + " "	18·20900
" + ash of filter-paper (0·0018) ..	18·08120
Ignited SiO_2 found	0·12780
Total loss on ignition	0·07600
6 per cent of weight of ignited SiO_2 for water retained at 212° F.	0·00767
Gr by loss on ignition	0·06833

Multiply weight of ignited SiO_2 found by 46·66, and divide product by the weight of iron employed; result shows percentage of silicon in the pig-iron. Multiply Gr by loss on ignition, by 100, and divide product by weight of iron employed; result shows percentage of Gr in the pig-iron.

In the case of steels, &c., the weight of the sample used should be about 3·5 grms., and the quantities of acids employed throughout increased in relative proportion.

(To be continued).

PROCEEDINGS OF SOCIETIES.

TYNE CHEMICAL SOCIETY.

Inaugural Address, Session 1873-4.

By W. W. Proctor, President.

I have thought that it might not be without interest to bring before you this evening a few notes on some analytical subjects. Although to some of you they may not appear altogether novel, they will have this point of interest in their favour, that they embody the results of practical experience, extending in some cases over a considerable period, and may thus claim some credit for utility which I do not seek for their novelty.

The enormous increase in the price of coal has excited universal attention, but as to the causes of this increase I do not mean to touch at present. There is one cause, however, which is universally admitted to have had a large share, and that is the enormous development of the iron trade of this country. Not only has this enormous development tended largely to give increased value to our coal, but it has also shown us that large and practically inexhaustible as our stocks of iron ore really are, they are not sufficient, but require supplementing from other countries. And this is due to a very simple reason, and one well known I dare say to you all, namely, mainly to the presence of phosphorus in the ores, which renders the iron unfit for use for many purposes.

As no simple method has, up to the present date, been discovered for removing this evil, the efforts of the ironmaster are chiefly directed to prevent the introduction of this element into his furnaces. Thus the task of detecting and estimating phosphorus in ores, otherwise suitable for the manufacture of iron, is a task of daily occurrence with the chemist; and perhaps there are few estimations which have excited more attention, or engaged the labours of a larger number of chemists than that of phosphorus. I do not propose to speak to-night of the estimation of phosphorus when it exists in large quantities in combination with lime, alumina, &c., when it plays a most important part as an element of extremely useful application in agriculture, but to confine myself to its estimation when existing in small quantities as "matter in the wrong place," to apply to it the definition of "dirt" as given by a late distinguished statesman.

One of the best methods of separating and estimating phosphorus when it exists along with iron, alumina, lime, magnesia, &c., and that I think which has been most generally adopted by chemists in the analysis of iron ores, is that in which the phosphorus is first separated from the other elements as a basic phosphate of iron, and afterwards converted into a basic phosphate of ammonia and magnesia, and ultimately weighed as pyrophosphate of magnesia. As this method is of general application, and its minute details may not be known to all of you, I shall describe it at some length, more especially as it is my object to compare it with a simpler and as I think better mode now coming into general use among chemists, namely, that in which the phosphoric acid is precipitated as phospho-molybdate of ammonia, and either weighed as such or dissolved in ammonia and precipitated as basic phosphate of ammonia and magnesia, and then weighed as pyrophosphate of magnesia.

A suitable quantity of the ore to be examined, say 3 to 5 grms., is weighed and digested with aqua regia at a gentle heat in a small beaker covered with a watch-glass; when the action has finished the cover is rinsed with a little water, and the whole evaporated to dryness, and exposed to a gentle heat until the excess of acid is expelled, and the whole of the silicic acid converted into the insoluble state; hydrochloric acid is then added, and after a short digestion boiling water is added, and the solution filtered from the insoluble matters, which are well washed. To the solution, which is heated to the boiling point, sulphite of soda is added to reduce peroxide of iron to the protoxide, a change which is readily recognised by the colour of the solution; when this has taken place the solution is boiled to expel excess of sulphurous acid, and then nearly neutralised with ammonia or carbonate of ammonia, excess of acetate of soda, potass, or ammonia added, and the liquid boiled. If the colour of the precipitate be distinctly red, it contains sufficient iron to carry down the whole of the phosphoric acid; if, however, it is whitish, a deficiency of iron is indicated, and this must be remedied either by the addition of a few drops of chlorine water, or, what is perhaps better because simpler, solution of perchloride of iron is added drop by drop until the appearance of the precipitate shows that the iron is in excess. After washing the precipitate well with boiling water it is dissolved in hydrochloric acid. Before proceeding further, I may observe that, although the filtrate from the phosphate of iron is quite clear as it first runs from the filter, it almost immediately becomes turbid, and deposits a red precipitate. As this result is owing to absorption of oxygen from the air, and consequent conversion of ferrous into ferric salts, it need not trouble the operator. To the acid solution, containing the basic phosphate of iron, citric acid is added until a precipitate is no longer produced by ammonium hydrate, which is then added in large excess. An ammoniacal solution of magnesium sulphate, containing sufficient ammonium chloride to retain the magnesia in solution, is then added, and the whole well stirred for about ten minutes, and then put aside for twenty-four hours. The precipitate of basic phosphate of magnesia and ammonia is then filtered, but as it always contains a little iron, it is only very slightly washed, and then re-dissolved by a little hydrochloric acid being put into the beaker in which it was precipitated; this is then warmed and poured over the filter, which is washed free from acid. To the solution a few drops of citric acid, a drop or two of the magnesium mixture, and a large excess of ammonium hydrate are added, the whole well stirred, and put aside for eighteen hours. The precipitate is then collected on a filter, washed with ammoniacal water, dried, and ignited, gently at first, and afterwards very strongly, and the precipitate weighed as pyrophosphate.

When the quantity of phosphoric acid amounts to 0·1 per cent and upwards, this method, apart from the time and labour bestowed upon it, is unexceptionable. The phosphoric acid is obtained in a form which is readily collected and weighed, and of which the composition is well and definitely known. It does not demand any unsual skill or manipulation, or the exercise of any special care, other than that necessary in any chemical operation. On the other hand, the length of time which it requires, and the constant attention demanded of the operator by the number of filtrations, solutions, &c., militate seriously against its use, especially when many determinations have to be made at once.

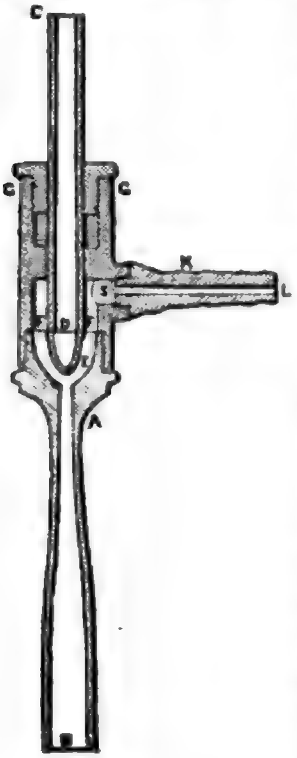
Although this method has been modified to some extent by Mr. Spiller, it is still open to most of these objections, and thus it is well to adopt an entirely different mode of procedure, namely, a modification of Sonnenschein's method by means of molybdic acid. I may premise, however, that I was quite unsuccessful in obtaining correct results by following the method described by Fresenius. But without endeavouring to criticise it, I shall describe the process which has succeeded in my hands in giving correct and rapid results, and for the main details of which I believe we are indebted to Professor Eggertz, to whom chemists, especially metallurgical chemists, are under obligations for several quick and accurate methods of analysis.

The ore or metal, after treatment with aqua regia and evaporation to dryness, as described in the first method, is treated with hydrochloric acid. This is heated for some little time, any large excess of acid being driven off, taking care, however, that there is no deposition of basic oxide of iron during the evaporation. A little boiling water is then added, and the whole passed through a small filter. By the exercise of care it is possible to obtain the filtrate and washings in less than 50 c.c., and it is important that the bulk should not exceed 100 c.c. The solution is now heated to boiling, and it is convenient to use a flask for this purpose, as it admits of shaking the liquid with facility. It is then taken from the lamp, and an excess of solution of molybdate of ammonia added. This is made by dissolving 200 grms. of molybdate ammonia in 200 c.c. of ammonia (sp. gr. 0·880), filtering if necessary after making up the quantity of water to 1 litre. Nitric acid is now added to the solution containing the phosphoric acid until the ferric oxide, &c., is dissolved, and a yellow crystalline precipitate is thrown down containing the whole of the phosphorus. Much care is requisite in the addition of the nitric acid, as a deficiency or a large excess are both injurious. It is well to add the acid drop by drop and when the yellow precipitate appears to add a few drops in excess. After standing a short while the precipitate may be filtered off, but I prefer allowing it to stand overnight, and to filter next morning through a weighed filter, washing it slightly and very carefully with water acidulated with one-fiftieth of its bulk of nitric acid. The filtrate ought to be tested to see that excess of molybdate of ammonia is really present. Should this not be the case, it is well to add more and use this merely as a guide; making a second determination, and adding excess of molybdate ammonia at first, so as to obtain the whole of the phosphoric acid in the first precipitation. It may now be dried in the water-bath, but it is well not to allow the temperature to rise above 180° F., on account of the action of the acid on the paper. It is then weighed, and the phosphorus calculated. 100 parts of the yellow phospho-molybdate of ammonia contain 1·63 parts of phosphorus.

This is a very simple and reliable method of estimating phosphorus when carefully and properly conducted. In fact, as the precipitate contains so small an amount of phosphorus, it is, so far as I am aware, the *only* method of accurately estimating those small quantities of phosphorus which the chemist would otherwise be compelled to put down as "traces." As this method requires some amount of practice and attention to little points of detail, the chemist who uses it for the first time will do well either to work with known quantities of phosphorus or to check his results by the adoption of some other method; and it is for this reason that I have described with such fulness the two processes. In connection with this subject, I may just refer to a valuable paper by Mr. T. R. Ogilvie, read before the Glasgow Chemical Society, in which the separation of large quantities of phosphorus from these bases is treated of, and this process made available for the estimation of phosphoric acid in coprolites, wavellites, apatites, and other mineral phosphates.

I have spoken so much about filtering, that it may perhaps be appropriate here to make a few remarks upon recent improvements effected in this simple but very important part of a chemist's duties. The introduction of the Bunsen pump into laboratories has greatly tended to shorten and lighten the chemist's labours in this direction. Not only are precipitates much sooner filtered and washed, but are in many cases immediately ready for the crucible without further drying.

M. H. Lasne has lately described an aspirator which, acting on a different principle from that of the Bunsen, produces all the effects of the latter, and may be used with advantage in laboratories which are so situated as to render the application of the Bunsen pump somewhat difficult. As the use of the Lasne aspirator depends upon the fall of water through a tube of unequal bore, the fall of water required is not so great as that of the Bunsen, a point of some importance to laboratories situated on the ground floor.



Its action may be readily understood by reference to the figure, which I have taken from M. H. Lasne's paper in the *Bulletin de la Société de Chimique de Paris*. Its most important part is the diverging tube, A B; the water is brought by another tube, C D, which delivers in front of the first by a little narrower orifice, E. These two tubes are fitted into a common chamber, F, which, by means of the lateral orifice K L, can be put into communication with the apparatus in which we wish to make a vacuum. The upper tube slides in a sort of stuffing box, G, which allows the distance between the two orifices to be varied at will. As this apparatus is intended for use in laboratories where several stopcocks being fixed on the same main pipe, the pressure of the water varies according as we open or close them, this apparatus has presented the inconvenience that the vacuum being partially obtained, the water, owing to too great a diminution of the pressure, might, in place of continuing its course, be aspirated into the bell jar. It w easy to remedy this by placing a valve. s. which from outside to inside, and which permits the air to pass without allowing it to return again. Besides obviating the inconvenience mentioned above, this valve has the further advantage of retaining the vacuum like a good stopcock. The apparatus is represented one-half its real size.

While, however, the use of either of these two instruments renders filtration a very simple, and in most cases short, operation, it is not every laboratory which possesses one, and the chemist thus situated must continue to use the old methods. Now it is somewhat singular that, despite the improvements in almost everything else, the chemist still uses the same form of filter which has been in use almost from time immemorial. And yet it is not difficult to point out several defects in it. I shall not speak of the plaited or folded filter, which was used to some extent in my student days, and which seems now to be almost entirely given up, at least for analytical purposes, from causes not difficult to point out. The numerous plaits, while facilitating filtration, weaken the filter, and render it very difficult to wash a precipitate clean, thus greatly restricting its use. Returning, however, to the plain filter now in general use. It consists, as you all know, of a circular piece of paper folded twice in the direction of the circumference; on being opened one-half of the filter has a surface of a single fold of paper, while the other half presents a surface of three thicknesses. I need scarcely point out to you that not only is the filtration considerably retarded by this, but the drying also requires a longer time. To avoid these inconveniences, Mr. R. Rother has proposed a new form of filter, which, as it has been in use in my laboratory for the last eight or nine months with considerable advantage, I now desire to bring before you. A circular piece of paper is taken as before; this is cut through the line of the diameter; each piece is then folded across the line of the radius, and the double edge of the cut side turned down and folded over two or three times, and then the seam pressed down with a paper-knife or any other hard surface; and two filters are thus obtained. As there is only a single thickness of paper all round, except at the seam, solutions are filtered more rapidly, precipitates dried more easily, and any errors arising from imperfections in the paper reduced to one-half, inasmuch as for the same filtering surface only one-half the quantity of paper is required as for the old filters. I have found the amount of lime in filtering-paper as usually sold make a serious difference in long analyses, and it is no mean advantage to have errors of this kind, and also those of the amount of ash in the paper, at once reduced to one-half, while the process of filtration is considerably quickened. I have now used these filters many hundreds of times,—in fact to the exclusion of all others, except when the Bunsen pump was used,—and have not had a single failure which could be legitimately traced to the fault of the construction of the filter. As in the use of the Bunsen pump, it is necessary to have funnels of an angle of 90°, which are difficult to obtain correct, and when ordinary funnels are used and the paper folded to suit this angle, the papers frequently burst, I find it often just as convenient to filter through this new filter instead of running a risk of failure with the Bunsen pump. I generally keep the paper cut in rectangular-shaped pieces, and, after folding, cut with scissors to the shape of a quadrant

Perh he most unpleasant operation which the analytical mist has to perform is the preparation and use of hydrosulphuric acid by the method in common use, namely, by means of ferrous sulphide and hydrochloric acid. I shall not speak of the inconveniences arising from stoppages of the sink by particles of ferrous sulphide and constant evolution of hydrosulphuric acid therefrom, of the dirty state of the tubes and apparatus just when wanted, nor of the blackening of the lead paint, &c., because most of these inconveniences arise from simple lessness, and may, to a certain extent, be remedied by anagement. The process, however, is a faulty one, even with Kip's three-bulbed apparatus, of which so much use is made by Rosé, and which is a great improvement on the usual two-bottles arrangement, as it gives off the gas regularly and under control, and there is not much escape of gas or waste of ferrous sulphide when the apparatus is not in use. Even this, however, does not avoid all the defects. I have obtained a fair degree of success by the use of sulphur and paraffin, as recommended first, I believe, by Mr. J. Galletly. The apparatus I use is simply a Florence flask, connected by a wide piece of india-rubber tube with a short piece of curved Bohemian glass tubing, connected by a cork with another piece of tubing, of nearly the same bore, loosely filled with cotton-wool; to the other end of this tube is attached a short piece of tubing with india-rubber connection, by means of which the delivery tube dipping into the solution is connected. About equal parts of sulphur and paraffin are put into the flask, the india-rubber tubing slipped over the neck, and the flask heated over an argand burner. Hydrosulphuric acid soon comes off, and the evolution may be easily regulated by the heat. As the gas, unlike that given off by the ferrous sulphide, does not contain free hydrogen, solutions are more easily saturated by this gas, and the solution made by passing through water seems also to be more easily saturated, and to keep better and longer than that prepared by the usual method. In practice, I find almost all operations may be pretty conveniently made by the use of this solution, and that it is only rarely that it is necessary to make the gas. The solution has a slightly milky appearance, owing probably to finely-suspended sulphur; but I have not found this to interfere with its use in qualitative or quantitative analyses.

I have tried the method given by Mr. Skey, who writes from the Antipodes, and recommends the use of a mixture of granulated zinc and galena acted on by hydrochloric acid, but, beyond verifying the fact that hydrosulphuric acid is readily given off by this method, I have not pursued the subject further, and only mention it for the sake of the suggestion that he throws out, of making a galvanic connection by means of wires, and so obtaining at will a constant supply of the gas. We have among our members a gentleman who has had much experience both with chemical and electrical apparatus, and if he could be induced to give his attention to this, and perfect a form of apparatus for this purpose, he would confer a favour upon many chemists, and might usefully and profitably occupy an evening meeting in exhibiting and describing the apparatus.

Probably, however, all these processes will in course of time be superseded by the method described by Mr. J. P. Cooke in a recent number of the Chemical News. In this method, by a not very complicated arrangement of Winchester quart bottles, connected by india-rubber tubing and glass tubes with a water-head of about 30 feet, a solution of hydrosulphuric acid is obtained under pressure containing a large amount of hydrosulphuric acid in solution. By drawing this off by means of a soda-water syphon, the solution may be used with as much convenience as any other reagent. It might probably, in practice, be found worth while for the dealer in chemical reagents to supply this reagent, which he might easily do in the ordinary gazogenes, to the great advantage and convenience of the chemist. I may say that I have not myself tried this method, but have no doubt as to its success.

Perhaps I may not inappropriately bring these desultory, and I am afraid somewhat tedious, notes to a conclusion, by directing your attention to a modification of the usual alkalimetric test, kindly pointed out to me by one of our members at the close of last session, and which I have since had the opportunity of trying a few times with good results.

M. Henry, a chemist engaged in a beet-root sugar manufactory, having, owing to the exigences of the manufacture, constantly to test alkalies at night, and having found, as most of us have done, considerable difficulty in judging the changes of colour by artificial light, bethought himself of trying the effects of monochromatic light, and this succeeded so well that he now prefers testing alkalies by this method to that by daylight. When I heard of this method, I took a wire which had been used for blowpipe work, and which contained some salt of soda in the loop, placed this in the flame of a large Bunsen burner, and found that I had got quite sufficient illumination for the purpose. I have since tried, without, however, any better result, a wire bent into a ring, and wrapped round with tow; on dipping this into solution of salt, and placing in the flame, a yellow sodium flame is obtained as long as the tow is moist, and only requires to be moistened with a little water from the wash-bottle to keep up the flame any length of time. Doubtless many other methods will readily suggest themselves for attaining the same end. On examining the liquid containing the litmus, which is blue by daylight, it appears by the sodium flame as a black liquid resembling ink, and, on adding the acid, immediately the drop is added in excess this black inky fluid becomes clear and colourless as water; this colourless liquid of course by daylight appears red. The change is very sudden, and by this slight modification an alkali may be tested quite as readily and precisely by night as by day.

In conclusion, I have to thank you for your kind attention and the courtesy with which you have listened to me; and, in declaring the Winter Session opened, have to express a hope that you will endeavour, both by your papers and discussions, to render the meetings of this session at least as interesting and instructive as those which have preceded them.

CORRESPONDENCE.

A PROBLEM.

To the Editor of the Chemical News.

Sir,—I beg to submit the following solution of the problem of "Analysis" to the criticism of your readers:—

Take first a portion of the solution in a test-tube; add a drop of HCl: the appearance of a turbidity, not removed by dilution or heating, indicates that the Hg is present as sub-salt. Therefore pass Cl through the main solution, to which the abstracted portion has been returned. Add HCl, and warm, with shaking to expel Cl; then $AuCl_3$ in sufficient quantity to throw down all the Sn, aiding the action with heat. Filter, add Na_2CO_3 to strong alkaline reaction, boil, then NHO_3 in excess; filter. After thus removing the Sb, precipitate the Pb with Na_2SO_4, and some NaHO to neutralise the free acid; filter, digest the filtrate with SO_3H_2 to precipitate the Hg; filter, add some more SO_3H_2, and some KSCN to precipitate the Cu; filter, nearly neutralise with soda, and add water largely; allow to stand some time, and then filter off the Bi; add tartaric acid (after having converted the arsenious acid in arsenic acid with Cl), then magnesia mixture; allow to stand about twelve hours, then filter off the As. Add HCl in excess, and pass H_2S to precipitate the Ca; filter. Remove excess of H_2S, HCl, and tartaric acid, by boiling and passing Cl; allow to cool, add sodium acetate in excess, then acetic acid, and pass H_2S until all Zn is precipitated. Filter, add SO_4H_2; boil to expel all acetic acid, then add ammonia and Am_2S; afterwards very dilute HCl, with stirring; filter off the CO. Neutralise with soda, pass Cl, boil to expel the excess, add $BaCl_2$ until precipitation ceases, then $BaCO_3$; allow to digest, and filter off the Mn. Fuse the residue with Na_2CO_3 and $NaNO_3$, treat with water; add AmCl, digest, and filter; Cr remains in solution. Fuse the remnant with NaHO; treat with water and a few drops of NH_3; filter; Al is found in the filtrate, and Fe in the residue.—I am, &c.,

Wm. Johnson.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 15, 1873.

Researches on Certain New Derivatives of Butyl.—M. A. Cahours.—The author, having at his disposal a quantity of butylic alcohol of fermentation in a state of great purity, undertook to prepare certain organo-metallic radicals belonging to this series, in order to compare it with the corresponding compounds of the inferior series. The investigation offers a peculiar interest on account of the anomalies presented by this alcohol, which, though primary, is widely different from the normal butylic alcohol, the true representative of methylic, ethylic, and propylic alcohols. This product has a boiling-point lower by several degrees than that which theory would assign, and these differences are found in all its derivative ethers. M. Cahours prepared stan-butyl, mercur-butyl, zinc-butyl, aluminium-butyl, silico-butylic ether, and oxalo-butylic ether.

Laws of Magnetisation of Steel by Currents.—M. Jamin.—During passage of the current in the bobbin the bar takes a strong magnetisation, which the author calls the *total*. Let $x+z$ be the square root of the detaching force. After opening the circuit there remains a weak residue of *permanent* magnetism x. The difference between total and permanent magnetisation he calls *temporary* magnetism, or y. If i denote the intensity of the current, the total magnetisation $x+z$ increases with i to a limit corresponding to $i=\infty$. When the current is interrupted there remains only the permanent magnetism, x; but this grows also with the intensity, i, of the anterior current. The transitory magnetisation, y, is represented by the difference between $x+z$ and y. *En resumé*, the transitory magnetism, y, is independent of the permanent state. It is only a function of i, and is added to the magnetism preserved by the bar after the current has ceased. M. Jamin next examines the case where, after permanent magnetisation is produced by a direct current, a contrary increasing current is sent through the bobbin. He seeks to explain the laws observed by the following hypothesis. The magnetism is not only expanded on the exterior surface of the bar, but each interior point, to a limited depth, is a pole. With an intensity, i, the magnetisation will penetrate to a depth e; with a greater intensity, i', the magnetisation will attain a greater thickness, e'. (1) This hypothesis explains the difference (too little noticed hitherto) between total magnetisation only maintained by the current, and an equal permanent magnetisation equal to the first, but stable. It may occur that the total magnetisation produced by a weak current penetrating to a depth, e, is equal, in absolute value to the permanent magnetisation remaining after action of a more powerful current penetrating to a greater depth, e', but having at each point less intensity. (2) The ulterior action of a current of the same direction less than i, or at most equal to i, will be to produce the transitory magnetisation, z, due to this current; this will occur whatever the depth, e', to which the first magnetisation has penetrated; that is, whatever the previous state of the bar, provided that e' is greater than e. (3) But when the current, i, ceases to flow the layer of thickness, e, will cease to be supersaturated; we then find the original permanent magnetisation.

Additional Remarks on the Nature of the Chemical Elements.—M. Berthelot.—The study of specific heats tends to establish a positive character distinguishing the simple substances of the chemistry of the present from its compound substances; and the importance of this character increases by reason of the mechanical signification now attached to notions of specific heat.

Evaluation, in Mechanical Units, of the Quantity of Electricity Produced by a Battery Element.—M. Branly.—The object of the author's experiments was to estimate in electrostatic measure the quantity of electricity transmitted in a second by a battery element in a circuit of given resistance. An insulated metallic sphere received n times per second a constant charge A, which was removed each time by connecting with the ground by the bobbin of a galvanometer. The quantity of electricity, n A, traversing the bobbin deflected the needle; and it sufficed to compare this deflection with that caused by the flow of electricity from a Daniell element in a known circuit. It was verified that the charge of the sphere is proportional to its radius, to the potential of the pile, and to the number of discharges. The conclusion arrived at from the experiments is, that a current of intensity, $\frac{1}{111000}$, causes to circulate, in a second, a quantity of electricity represented by—

$$104699 \times \frac{371{\cdot}4}{51{\cdot}25} \text{ units.}$$

Water of Wells in general, and of those of the Town of Beausais in particular, from the Hygienic point of view.—M. Decaisne.—This town is shown to be greatly in want of sanitary improvements.

Falling Stars of December.—M. Tisserand.

Bulletin de la Societe Chimique de Paris, tome xx., No. 11, December 5, 1873.

Action of Aërated Water on Lead.—M. Fordos.—The danger arising from the employment of leaden pipes has been much exaggerated, and is certainly far smaller than that resulting from the use of shot in cleaning out bottles. The author, having shaken up shot in bottles in the ordinary way, filled four of them respectively with white wine, red wine, quinine wine, and vinegar. After allowing the liquids to stand for a few days, he discovered lead in solution. These experiments may serve, he adds, to explain the frequent presence of lead in the human system, a phenomenon so general that Hervy, Devergie, and Orfila have considered it a normal constituent.

Action of the Waters of the Seine and Ourcq upon Lead.—M. Fordos.—The author finds that the waters of the Seine and Ourcq attack lead, though more slowly than distilled water. The action is more rapid the more finely divided the metal. New lead is less rapidly attacked than old. The product of the action of these waters consists of carbonate of lime and carbonate of lead, and these waters, after this reaction, contain no lead in solution, or merely an infinitesimal quantity.

Certain Minerals from the Bismuth Deposits of Meymac.—Ad. Carnot.—*Native Bismuth*, with a crystalline fracture, bright, with its ordinary lustre. *Sulphide of Bismuth*, of fibrous texture, black, slightly bluish, and containing traces of lead, iron, antimony, and arsenic. *Oxide of Bismuth*, or, rather, *Hydrated Carbonate*, derived from the sulphide, whose fibrous structure it preserves, but presents appearances otherwise much varied. *Antimonial Bismuth*, with a little lead, arsenic, and sulphur, &c., of a greyish colour and a metallic aspect. *Mispickel*, containing small proportions of antimony, bismuth, and lead. *Carbonate and Sulphate of Lead*, with their customary appearance. *Molybdate of Lead*, in small tubular crystals, sometimes presenting a honey colour and a fatty lustre of tolerable brightness, sometimes covered with a brown ferruginous coating. *Wolfram*, of easy and brilliant cleavage, containing, along with the usual constituents, a proportion of tantalic acid much higher than has hitherto been observed. *Tungstate of Lime*, in lamellar masses, with its peculiar fatty lustre and a greyish brown colour. *Hydrated Tungstic Acid*, sometimes of a pale yellow shade, more often of a deeper yellow, and of an aspect like that of wax; it contains variable proportions of lime and iron, and appears to result from an alteration of tungstate of lime by vitriolic waters coming from the decomposition of pyrites.

Extraction of Vanadium, and on an Application of Vanadiate of Ammonium.—M. R. Bœttger.—The author has found vanadium in variable proportions in all samples of pisolithic iron, and that in a larger proportion than hitherto supposed. The ore, well powdered, is heated for a long time to redness with nitre and soda. It is extracted with boiling water, and neutralised with nitric acid free from nitrous vapours, the reaction being left feebly alkaline. The bulk of the alumina and silica is thrown down. The filtrate yields, on the addition of nitrate of baryta, a precipitate of vanadiate of baryta, from which the vanadic acid is easily separated. To make the fine vanadic ink, 1 part of pyrogallic acid is ground very fine with 3 parts of gum arabic and 3 parts of vanadiate of ammonia, with the addition of rain-water.

Treatment of Telluriferous Minerals.—M. V. Schrœtter.—The author shows that it is better, after treating the ore with aqua regia, to precipitate the gold with oxalic acid or glycerin rather than with sulphate of iron. The tellurium thrown down afterwards is more easily purified, and the gold falls free from tellurium. The selenium which is found in telluriferous minerals in larger amount than commonly supposed is precipitated along with tellurium by the action of sulphurous acid. The first portions of the precipitate contain all the selenium, with small quantities of tellurium. Their separation is easily effected by treating the precipitate with nitric acid, and distilling the liquid filtered from the tellurous acid. In the precipitation of tellurium by sulphurous acid, there comes a moment when the precipitation ceases, although the current of gas continues and the solution still contains tellurium, but the whole of the latter falls on diluting with water. In fact, a solution of tellurium saturated with hydrochloric acid is not precipitated by sulphurous acid.

Sensitive Reagent for Free Oxygen.—M. R. Bœttger.—The reagent is ammoniacal solution of nitrate of silver, not containing free ammonia. On adding a few drops of this solution to water containing peroxide of hydrogen and boiling, the silver is at once reduced.

Revivification of Animal Charcoal.—MM. Pfleger and Divis.—The authors use a dilute and boiling solution of ammoniacal salt. The first effect of this is the elimination of the lime or carbonate of lime absorbed by the charcoal. The ammonia thus set at liberty acts upon the organic matters absorbed. The apparatus is so constructed that the excess of ammonia traverses a series of receivers containing the carbon to be treated, and finally enters a condenser.

Tome xx., No. 12, December 20, 1873.

Rotatory Power of Mannite.—M. L. Vignon.—The author succeeded in estimating the rotatory power of mannite by mixing its saturated solution with a similar solution of boracic acid. Such a solution examined, after filtration, with the Soleil apparatus in tubes of 200 m.m., gave a constant deviation of 5 divisions to the right. There is no combination between the mannite and the boracic acid. Borax increases the rotatory power to 21 divisions in the same direction.

Determination of Oxygen in the Gases which Escape from the Lead Chambers.—M. L. Vogt.—The author describes an apparatus by means of which a known volume of chamber-gas is collected, after having made it pass through a solution of bichromate of potassa and a caustic potassa lye contained in Liebig's bulb-tubes. He adds then to the gas a solution of ammonio-ferrous sulphate, and a sufficient quantity of ammonia to precipitate all the ferrous oxide. The oxygen of the gaseous mixture is then entirely absorbed by this ferrous oxide. The water is then allowed to re-enter the apparatus, when the quantity of water absorbed indicates the volume of oxygen. The precipitate of oxide may be also re-dissolved in sulphuric acid, and titrated with permanganate. The apparatus consists of an aspirator-flask, filled with water recently boiled. This aspirator is connected with the gas to be taken, and the water is allowed to escape. The apparatus is then filled with the gas, which has been previously freed by the bulb-tubes from all gases except oxygen and nitrogen. There is a tube with a tap fixed to the flask for the introduction of the reagents.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 14, December 4, 1873.

Spurious Wines.—Count Sokolnicki, a proprietor of vineyards at Medoc, informs us that a chemist, so-called, is selling to the wine-forgers of the Gironde a liquid of which a few drops suffice to colour a wine. An œnanthic liquor, simulating the bouquet of Medocs, is sold openly at Bordeaux. A solution of sugar is allowed to ferment on the pressed grapes, the colour and the flavour are added, and with these materials wines of the best growths are counterfeited.

Manufacture of Permanent Beer.—M. Pasteur.—The author recommends the use of a pure yeast—the mode of preparing which he does not describe—free from vibriones, bacteria, *Mycoderma aceti*, &c. With such yeast, the process of fermentation can be carried on in the absence of air, or in the presence only of limited quantities of pure air. Beers thus made can, he declares, be preserved for an indefinite length of time, even at temperatures of 20° to 25° C.

Revue Scientifique de la France et de l'Etranger, No. 23, December 6, 1873.

Association Française pour l'Avancement des Sciences, Lyons Meeting.—(Geological Section, Session of Aug. 27, 1873).—M. Friedel described a new mineral species, to which he gave the name *Delafossite*, a combination of sesquioxide of iron and suboxide of copper, Fe_2O_3,Cu_2O. It resembles graphite to such an extent that it has figured under that name in collections for fifty years. Its colour is grey, it marks paper, has a decided and easy cleavage, and is found in small veins, enveloped in lithomarge. It appears to be found at Ekatherinenburg, Ural. M. Friedel announced that he had analysed a telluride of gold and silver from Kara Hisar, Asia Minor, and which belongs to the variety of Hessite named Petzite. Fra Onesimo exhibited to the Section a specimen from the iron mines of St. Leon, Sardinia. This specimen, concreted like the psilometane of Romanéche, consists of protoxide of iron, containing neither manganese nor hæmatite.

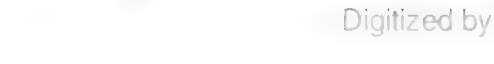
Reimann's Färber Zeitung, No. 43, 1873.

A considerable part of this number is taken up with strictures on a contemporary and rival, the *Muster Zeitung*. Not knowing the circumstances of the case, we can only say that it is "a very pretty quarrel as it stands."

Thereon follow receipts for a black on jaconnet, a black on moire, for printing a red and white on black ground, for a red-brown on woollen yarn, and a black and a grey on cotton-wool.

New Aniline Red.—M. Ferrière.—Ammoniacal solution of oxide of copper is poured into acetate of aniline, and saturated with sulphuric acid; a rich purple-red colour is produced. The liquid, after concentration, is allowed to stand, when crystals of sulphate of ammonia are deposited, and removed by filtration.

A methyl-aniline green, manufactured by Bindschedler and Busch, of Basel, was found by Appenzeller, on analysis, to be a double salt of perchloride of tin and the hydrochlorate of the green base. The following formula is appended:—



$$C_{40}\left\{\begin{matrix}H_{16}\\(C_2H_3)_3\end{matrix}\right\}N_3.2C_2H_3Cl+ZnCl+2HO$$

[The reader will perceive that, while the text speaks of chloride of tin, the formula indicates chloride of zinc.]

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, July and August, 1873.

This number contains no chemical matter.

NOTES AND QUERIES.

Spent Oxidee from Gas-Purifying.—"X. T." will thank Mr. George E. Davis to have the goodness to state his method of analysing this substance, or say where it may be found.

Valuation of Anthracen.—I shall feel greatly obliged if any of your readers will tell me how to proceed to estimate the percentage (approximatively) of anthracen, chrysen, and pyren in a sample of commercial crude anthracen.—T. H. D.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

3482. Did you not state in your book that you consider that a stock of fish tends to make the river pure?—Several years ago, at the time when I was making those enquiries, I was struck by this fact, which I have noticed repeatedly since, and which in fact I have noticed this week: that some fishes (minnows first of all, and various large common river fish) accumulate round the mouths of some of the sewers, and make them their great feeding grounds. It is very well known that there are arrangements in nature of that kind for the supply of food for various animals, which then prey upon one another. At all events I have noticed repeatedly near the mouths of our large sewers shoals of small fish feeding.

3483. Do you consider that they tend to make the river pure? If they convert, in the ascending series of organic matter, those putrefying excrements into healthy life, of course they do so *pro tanto*.

3484. If the river is rendered noxious by the sewage, does it not kill the fish, and thereby destroy the natural remedy for the evil?—The fish have then no chance.

3630. (To Mr. Walker.) Did you not state that your land had been actually deteriorated in value by these applications of sewage?—Yes, I understand that a gentleman who is going to become the tenant has had it valued, and that it was estimated as being £20 an acre deteriorated in value. It certainly has destroyed the fine herbage; it has left the ground covered with tufts of coarse grass.

3749. (To Mr. Dales.) Does not the earth possess great power of abstracting fertilising matter from liquid?—It does, and is a great deodoriser as well.

3750. Has this power of the earth to abstract these fertilising matters a limit?—Most decidedly.

3751. That limit is soon reached, is it not?—Yes, you may soon deluge it with the sewage.

3752. If you saw discoloured water running through the drains after you had applied the sewage, would you consider that that limit had been reached, and that the earth was already so saturated with fertilising matter that it would not abstract any more?—Of course.

3753. If you saw the water running from the land coloured you would consider, would you not, that the sewage was wasted, unless the drains were too near the surface?—I should.

3827. (To Mr. Tom Taylor.) Did they not propose, while their case was pending, to deodorise their water sewage with lime?—Yes.

3828. It was proved that that would be utterly destructive to the fish, was it not?—Yes, that was one point.

4040. (To Mr. Rawlinson.) Besides that sewage, we have the sewage of Kingston, Teddington, Twickenham, Oxford, and other places on the Thames itself?—Yes, that constitutes the 80,000 people whom I have mentioned above the point at which the companies are compelled to draw their supply of water.

4041. There are somewhere about fifty towns, I believe, on the Thames and its tributaries before the water reaches London?—I believe there are.

4041. The Wandle receives the sewage of Croydon, Carshalton, Mitcham, and other places, does it not?—Yes.

4063. (To Mr. Rawlinson.) The river Aire, which passes through Leeds and Bradford, is stated to be as bad as the Medlock; is that the case?—It is very foul.

Governments and Guaranteed Securities Permanent Trust. —Second Issue, 1874.—The principles of the present issue will be similar to those of the first, although some modifications in the details of carrying them out have been thought desirable. These embrace the permanent maintenance of the fund in its entirety; provision for reserve; payment of a fixed minimum interest; the further immediate distribution of a percentage of each year's realised profit as bonuses in cash to the whole body of certificate-holders; and, as far as possible, the redemption of certificates out of profits remaining after paying the annual bonus. The trust funds will be invested in carefully selected governments and guaranteed securities. Whenever any portion of the capital originally invested is set free by the operation of sinking funds or otherwise, it will be immediately re-invested in the same or a similar security. No single investment will exceed a maximum of one-tenth of the whole fund, and, to fortify thus obtained, one-half per cent on the nominal amount of the capital subscribed will be annually set aside to reserve. The revenue of the Trust up to £6½ per cent will be distributed as follows:—One-half per cent will be devoted to working expenses, one-half per cent to the reserve fund, five per cent to interest, and one-half per cent as bonus.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 2.—Medical, 8.
— Royal Institution, 2. General Monthly Meeting.
— London Institution, 4.
TUESDAY, 3.—Royal Institution, 3. Prof. Rutherford, M.D., "On Respiration."
— Civil Engineers, 8.
— Anthropological, 8.
— Zoological, 8½.
WEDNESDAY, 4.—London Institution, 7.
— Society of Arts, 8.
— Geological, 8.
— Microscopical, 8. Anniversary.
THURSDAY, 5.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8½.
— Royal Society Club, 6.
— Chemical, 8. Dr. Tommasi, "On the Action of Benzyl Chloride on Camphor." Dr. C. R. A. Wright, "On Isomeric Terpenes and their Derivatives (Part III., On the Essential Oils of Wormwood and Citronella.") Dr. H. How, "On Two Coals from Cape Breton, their Cokes and Ashes."
FRIDAY, 6.—Royal Institution, 8. Weekly Evening Meeting. M. Garrod, "On the Heart and the Sphygmograph."
— Geologists' Association, 7½. Anniversary.
SATURDAY, 7.—Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

1871.—FIRST-CLASS BRONZE MEDAL, *Royal Cornwall Polytechnic Society*. 1872.—SILVER MEDAL. 1873.—INTERNATIONAL EXHIBITION PRIZE MEDAL.

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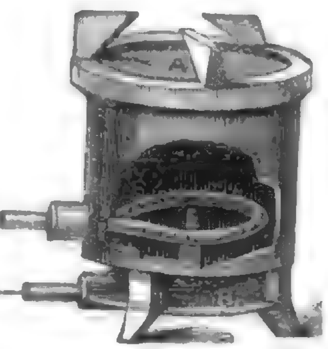

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" 15 on 1st May, "
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" 14 on 1st July,* "

£84 for each £100 subscribed.

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THE CHEMICAL NEWS.

VOL. XXIX. No. 741.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES F.R.S. ,&c.

(Continued from p. 55

SECTION III.—THE CHEMICALS.

IN this section I shall detail the methods adopted in the preparation of thallium and the reagents in a chemically pure state.

Water.

Ordinary distilled water is mixed with a little crystallised permanganate of silver, and boiled for about half an hour. An excess of sulphuric acid is next added, and it is again boiled for half an hour. The supernatant solution is then transferred to a German green glass retort, and distilled over a water-bath at the rate of about one drop a minute. The end of the neck of the retort is drawn out, and fitted tightly into the mouth of the flask used as a receiver. The first portions of water which distil over are always to be rejected, and the distillation is stopped when about three-fourths of the contents of the retort have come over. The product of this distillation is then mixed with freshly precipitated oxide of silver, and allowed to stand, with frequent agitation, until a few drops of the decanted clear solution exhibit an alkaline reaction. The water is then introduced into an apparatus shown at Fig. 3. *a*, *b*, *c* are three globes made of hard German glass, *a* and *c* holding about half a pint each, *b* holding about four ounces; they are connected by tubes as shown, the tubes being contracted at the places *d*, *e*, *f*. The water, containing a little oxide of silver dissolved in it, is introduced through *d* into the globe, *a*, until *a* is nearly full. The contracted part at *d* is then sealed up before the blowpipe, the end, *g*, is put into connection with the Sprengel pump from which the U-tube containing sulphuric acid has previously been removed, and the mercury set running. Heat is applied to the globe, *a*, containing the water until gentle ebullition (under diminished pressure) sets in, the globes *b* and *c* being kept cold with ice. This is continued until no more air, either from the apparatus or from the water, is carried down by the falling mercury. When this is the case, the globe *a* is allowed to cool, and the tube is sealed up at *f*, the vacuum being maintained as perfect as possible. By inclining the tube and globes, any water which may have distilled over from *a* into *b* or *c* is now poured back into *a*. The two end globes, *a* and *c*, are then placed in water-baths, whilst the centre globe, *b*, is immersed in melting ice. A gentle heat being applied to the water-bath containing *a*, distillation rapidly proceeds without actual ebullition, and water condenses in *b*, its condensation in *c* being prevented by warming the water-bath in which *c* is immersed. When about one-fourth of the contents of *a* has thus distilled over, the operation is stopped, and the bulb, *b*, removed by sealing the contracted part of the tube at *h*; any trace of ammonia which might happen to be in the water as introduced into *a* will thus have been collected in the bulb, *b*, and removed. The apparatus now has the appearance shown at Fig. 4. The globe *c* is now cooled in melting ice, and gentle heat being applied to the bath containing the globe *a*, distillation again proceeds, the condensation this time being into *c*. The first portions of water which come over into *c* are used to rinse out that globe, a dexterous movement throwing it all over the inner surface without throwing any of the liquid out of *a*. After two such rinsings, distillation is allowed to proceed without ebullition until four-fifths of the water has distilled from *a* to *c*. The tube is then sealed at the contracted part, *e*, and the globe *c* (Fig. 5), containing what I believe to be absolutely pure water *in vacuo*, may be set aside for future use. It will be observed that the water, almost chemically pure to begin with, has in this manner been distilled and further purified in the entire absence of atmospheric air. When some of this water is required for use, the glass tube is touched at *f* with a blowpipe-flame. As soon as the glass softens, the atmospheric pressure forces the glass in forming a fine hole. In this way no fragments of glass get into the water, as might be the case if the end of the tube were broken off after scratching with a file in the usual manner. As much water as is needed is driven out by warming the globe, and the water remaining unused may be sealed up again.

FIG. 3.

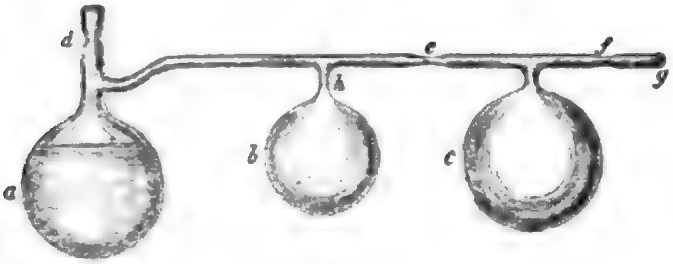


FIG. 4.

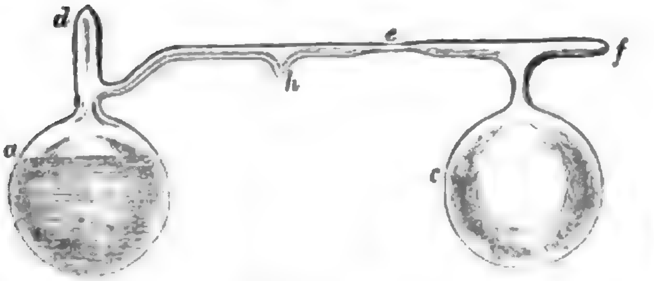


FIG. 5.

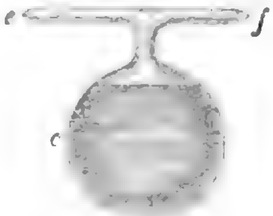
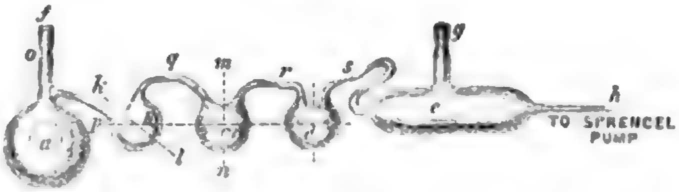


FIG. 6.



Water purified in this manner was employed in the final crystallisations of all the salts used in the investigation, in rinsing out the apparatus, and generally in all operations where its employment was likely to increase the accuracy of the result.

Nitric Acid.

The apparatus in which the nitric acid was prepared is represented in the accompanying figure (Fig. 6). *a*, *b*, *c*, *d* are glass globes, *a* being about 4 inches, and the others about 2 inches diameter; they are connected by fusion with glass tubes bent as represented in the drawing, and contracted at the points *o*, *p*, *q*, *r*, *s*. The cylindrical tube *e* is connected by means of a flexible joint, *i i i i* (Fig. 8), to the Sprengel pump: this joint consists of several pieces of glass tube held closely together by means of india-rubber tubing; the pieces of tubing are fastened with two or three turns of silk-covered iron wire. A little glycerin smeared over a joint of this description renders it quite air-tight, whilst the apparatus is capable of considerable movement. A mixture of glacial phosphoric acid and nitrate of silver in atomic proportions, and coarsely ground together in an agate mortar, is introduced into the globe *a* until half-full, the cylinder *e* having previously been filled through the opening *g* with pieces of caustic soda. The tubes *f* and *g* are now sealed up at the contracted portions, and the Sprengel pump is connected to *h*. Exhaustion is proceeded with, the apparatus being gently warmed at the same time until moisture is no longer visible, and the mercury is as high as the vapours present will allow it to rise. The bulb *b* is then immersed in a freezing-mixture, and heat is cautiously applied to the bulb *a*. The nitrate of silver and phosphoric acid soon fuse together to a clear liquid, and vapours of nitric acid mixed with nitrous acid are copiously evolved. The mixture froths considerably, and care must be taken that none rises so high as to pass into the bulb *b*. In this and the other bulbs nearly all the vapours condense, the small quantity that escapes being caught by the caustic soda in *e*. If, through spirting or inadvertence, some of the solid matter is carried over from *a* into *b*, the contents of *b* are easily decanted back into *a* by tilting the apparatus into such a position that the line *k l* would become horizontal: owing to the curvatures of the connecting-tubes, no liquid which might be in the bulbs *c* or *d*, and none of the pieces of caustic soda in *e*, can get out of their place. When the reaction between the phosphoric acid and nitrate of silver has been pushed as far as convenient (too strong a heat must not be applied, or the nitric acid is in part decomposed as it is liberated), the tube connecting *a* and *b* is sealed in a spirit-lamp, and the globe *a* drawn off. The bulb *c* is now thoroughly washed out with nitric acid by distilling a little over from *b*, letting it condense in *c*, and then pouring it back by inclining the apparatus so that the vertical line *m n* would become horizontal. The bulbs *b* and *d* are now warmed in water-baths, whilst the bulb *c* is immersed in a freezing-mixture. Distillation rapidly proceeds without ebullition, the acid almost entirely condensing into *c*. When about four-fifths of the contents of *b* are distilled into *c*, the tube is sealed up at *q* before the blowpipe, and the bulb *b* drawn off.

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* A Paper read before the Royal Society June 20, 1872.

Fig. 7.

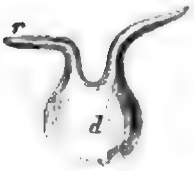


Fig. 8.

The next operation is to clear the acid in *c* and the rest of the apparatus from nitrous vapours. For this purpose the mercury of the Sprengel pump is set gently in motion, and the apparatus is very moderately heated from time to time until the vacuum is as perfect as the tension of nitric acid vapour will admit.* When this is effected, the bulb *c* is gently warmed in a water-bath, whilst *d* is immersed in a freezing-mixture. The temperature of *c* is so adjusted that distillation proceeds slowly without ebullition. When four-fifths of the contents of *c* have come over, the mercury-pump working slowly all the time, the connecting-tube is sealed before the blowpipe at *r*, and *c* is drawn off. The flame being then applied at the contracted part *s*, the bulb *d*, containing the pure nitric acid, and having the appearance shown at Fig. 7, is removed. The acid may be kept unchanged for any length of time, provided it be not exposed to the light. When required for use, the end of one of the tubes is perforated with a blowpipe-flame, as described under the heading "Water." By heating the bulb, any desired quantity of acid is driven out, when the remainder can again be sealed up.

(To be continued).

ON THE ESTIMATION OF THE ACETIC ACID IN ACETATE OF LEAD.

By HENRY SEWARD, F.C.S.

A sample of the acetate of lead is dissolved in distilled water, litmus solution added, and a moderate excess of standard carbonate of soda solution measured in. The whole is then filtered, and the precipitate washed till the washings no longer affect litmus-paper, the washings being collected separately, and evaporated before adding to the filtrate. The filtrate is coloured with a few drops more litmus solution, if necessary, and exactly neutralised with standard solution of oxalic acid.

Equal quantities of the standard solutions neutralise each other; therefore if in an estimation 10 c.c. of carbonate of soda solution has been added, and 8 c.c. of oxalic acid solution is required, the difference, 2 c.c. of carbonate of soda solution, is the quantity neutralised by the acetic acid.

ON THE SPECTRA OF BORIC AND PHOSPHORIC ACID BLOWPIPE BEADS.

By CHARLES HORNER.

Mr. H. C. Sorby has shown that many substances can be detected in blowpipe beads by means of their spectra, and in his excellent paper* describes several ingenious methods, including tests, whereby uranium may be recognised in quantities of $\frac{1}{10000}$th, or $\frac{1}{20000}$th grain. In a valuable communication† Major Ross proposes the employment of phosphoric and boric acids as better reagents than microcosmic salt or borax in some deparments of mineralogical analysis; and I have been recently engaged in a series of experiments, using these acids with a certain modification, and submitting the coloured beads to the test of spectrum analysis.

I have now the honour of laying before the British Association an account of the results.

In these experiments I employed the flame of a large composite candle as a source of heat; and the apparatus used was the same in all respects as that described by me in a late paper.‡

With reference to the various fractional quantities named in this communication, I must premise that each oxide had been carefully weighed to 1-50th grain, and the smaller portions obtained by repeated divisions. But although great care was exercised in these operations, yet the numbers must only be regarded as approximate.

Referring, then, to the diagrams; No. 1 represents the spectrum of a green bead containing about 1-100th grain of uranium oxide dissolved in phosphoric acid, and the spectrum closely corresponds with that of a concentrated acid solution of uranous phosphate, the differences being a slight expansion of the several lines, but *c* in the solution giving a single band instead of being double as in the spectrum of the bead. This spectrum varies with the amount of oxide present; for with 1-200th grain the faint band in the yellow, δ, is absent; and 1-800th in an almost colourless bead will give α, γ, and the double bands, ε, very faintly, whilst 1-1600th grain gives α as a mere line. This well-marked spectrum will allow of uranium being easily detected in the presence of many oxides, such as iron, nickel, vanadium, and copper, which furnish beads having orange, yellow, and green tints respectively, but without giving any absorption-bands. No. 2 is the spectrum of a phosphate of chromium bead, and by means of the fairly well-marked absorption-lines in the red 1-200th grain can be determined.

---

* If acid vapours pass into the tubes of the Sprengel pump they do no harm, being carried down at once. The small quantity which condenses in the tubes may be afterwards removed by passing some distilled water through the pump, and then drying with warm air, or by passing oil of vitriol through the pump.

* *Proc. Roy. Soc.*, vol. xviii., p. 197. "On some Remarkable Spectra of Compounds of Zirconia, and the Oxides of Uranium."

† *Ibid.*, vol xx., p. 449. "On Pyrology."

‡ Chemical News, vol. xxvii., p. 241. "On the Spectra of some Cobalt Compounds in Blowpipe Chemistry."

I may here remark that the slit of the spectroscope should be nearly closed, and strong lamp-light employed to see these lines, or, indeed, all the spectra lying near the red end.

The spectrum of a didymium phosphate bead is shown in No. 3, which exhibits the complement of lines due to 1-100th grain; but with 1-200th the line β is absent, and even 1-400th grain may be detected, but then the principal lines near the sodium line are only faintly recognised.

The only other compounds which I will now mention with phosphoric acid are tungsten and molybdenum oxides.

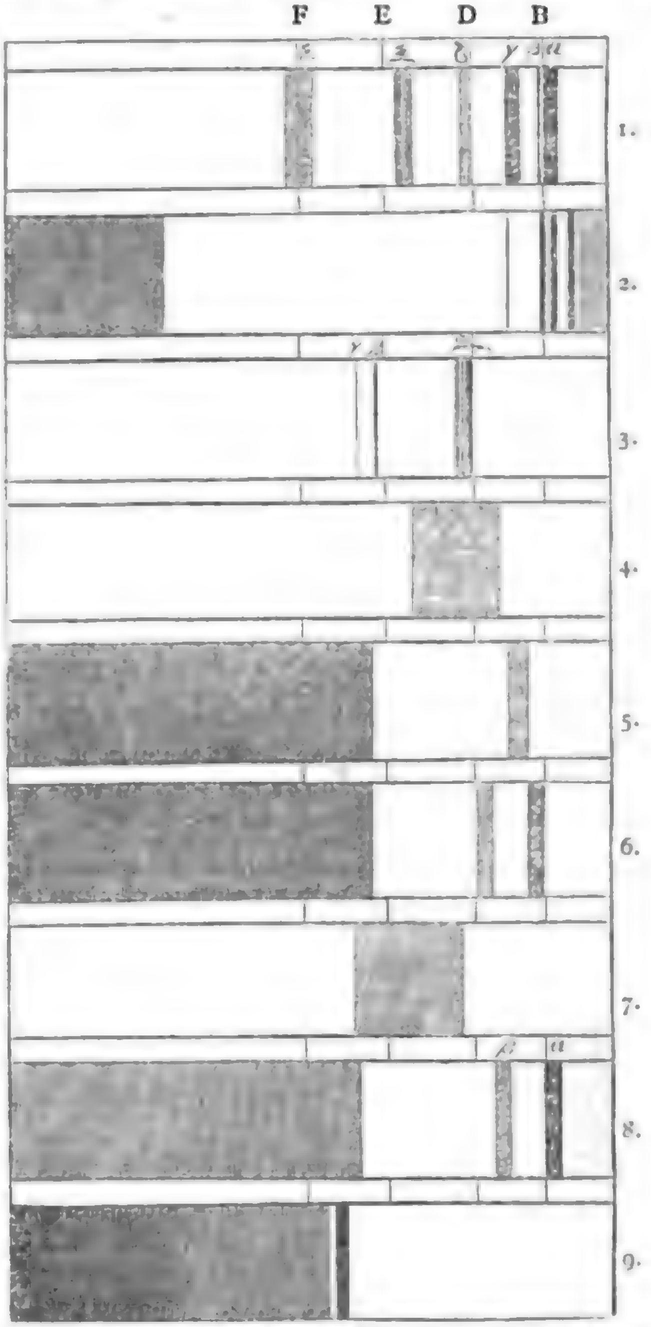
1-200th grain of tungsten oxide communicates to a phosphoric acid bead a splendid deep blue tint resembling cobalt dissolved in borax, especially when a trace of soda is added, and gives an obscure band drawn in No. 4. With molybdenum oxide the bead while hot is a pale green colour, the spectrum merely cutting off part of the red and blue, but when cooling turns a beautiful reddish-violet, and exhibits the broad absorption in the green ray shown in No. 7. I have found 1-200th grain should be dissolved to afford a good result; and the absorption occurring in the green enables us readily to discern any bands in the red or yellow rays, due to uranium, cobalt, didymium, or chromium which might happen to be present in any molybdate. In all the foregoing experiments the beads were exposed to the action of the reducing flame, and phosphoric acid continually added until they became clear.

When experimenting with boric acid I adopted the plan of fusing the substance along with the acid simultaneously, and in this way obtained some interesting results. The following proved to be the best method:—A small quantity of boric acid is taken upon the moistened loop of platinum wire, slightly heated that it may adhere, then the merest trace of the substance added, and the whole submitted to the apex of the outer flame until the bead is as free as possible from air globules. No more acid should be used than will just fill the loop, that the resultant bead may be no thicker than the wire.

I have found this to be an excellent test for nickel, which yields a bead giving out reddish-purple streaks with an exceedingly minute quantity of the oxide. Most remarkable are the results which I obtained with the oxides of tungsten, molybdenum, and cadmium when treated in the way just described; for so delicate is the spectrum method, that at least 1-10,000th grain of the two former oxides may be detected by means of the eminently characteristic absorption-bands.

If a bead of the acid is formed, and fused until it ceases to impart any green colouration to the flame, a little tungsten oxide then added, and again subjected to the action of the outer flame, on observing the cold bead with a lens it will be noticed bluish streaks surround the dark specks of undissolved oxide, and these, when examined by a microspectroscope, are found merely to cut off a small portion of the red.

When, however, a trace of tungsten is treated in my manner we obtain a bead giving a burnt-umber coloured precipitate, which shows a well-marked absorption-band with a general absorption extending over the blue to about the centre of the green, as depicted in No. 5. It appears this reaction is attributable to the sulphuric acid invariably present in ordinary pure boric acid, and that certainly one, if not two, sulphides are formed during fusion, the general absorption due to a brown sulphide, and the single band to a green or blue sulphide; for by adding sulphur to the well-fused bead named in the last paragraph, I succeeded in developing this spectrum. The bead should be wetted with distilled water, dipped into finely powdered sulphur, and held at the point of the outer flame. Most of the sulphur burns away, but the black residue remaining is often sufficient to give the reaction; if not, a second or third application never fails to be successful. When a little sodium carbonate is carefully added to the bead a second band is developed; and if the amount of tungsten and soda be comparatively large, and then submitted to the action of the inner flame, the colour while hot is a clear orange-brown, which on cooling turns an olive-green. Often, however, the constituents may be in a proportion which gives an almost colourless bead in the inner flame, but then the above colour reactions are easily produced by gently re-heating the bead. It must be borne in mind that much soda materially affects the delicacy of the test.



The deportment of a molybdenum oxide with boric acid affords the striking spectrum, No. 8, consisting of two well-marked bands and a general absorption—indicating, in my opinion, two separate compounds. The addition of soda produces the same colour reactions as the tungsten compound, and similarly interfering with the test. In the spectrum the bands are altered, β becoming darker, and α considerably diminished in intensity, besides both bands being slightly raised towards the sodium line. An interesting phenomenon may be observed by examining the boric acid beads as they gradually cool with a small hand spectroscope. If the hot beads are held a short distance from a bright flame, and at the same time the instrument adjusted for the spectra to appear in the field of view, as the temperature falls the absorption-bands will be seen to emerge from the extreme red end of the spectrum, faintly at first, but increasing in intensity as they approach their normal position. The same phenomenon may be witnessed over and over again by carefully warming the beads.

Having discovered the tests for tungsten and molybdenum depended on the presence of sulphur, it occurred to me that if any salt of cadmium were treated in like manner I should most probably obtain a bead yielding a precipitate of the yellow sulphide. Such I found to be the case, and it is at once the most efficient blowpipe test for this substance. A moderate heat is applied until a finely-divided precipitate diffuses itself throughout the bead, which is a deep brick-red hot, by transmitted light, and when cold, a bright canary-yellow by reflected light. If the bead is exposed to a prolonged high temperature the reaction is destroyed, since the salt dissolves, but may be reproduced by the addition of sulphur.

No. 9 diagram is the spectrum of the cadmium compound showing a narrow band between *b* and F, with some shading in the blue.

It will therefore be seen that in phosphoric acid beads we may readily distinguish even three or four substances in one bead by means of their spectra, a fact of special importance when examining complex minerals; also by the absence of certain bands, and variable intensity of others, we may form a fair judgment as to their relative quantities, and that most delicate reactions may be produced with boric acid by proceeding according to the methods adopted in this paper.

Finally I may remark that I have applied these tests to many minerals, including some molybdates and tungstates, with such satisfactory results as to conclusively show the desirability of more frequently employing the spectroscope in this branch of chemical analysis.

My thanks are due to Mr. G. M. Whipple, B.Sc., for his kind assistance in some laboratory operations during the period of my experiments.

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL,

IN CONNECTION WITH THE

SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

The chief object has been to concentrate the attention both of producers and consumers of fuel upon the great question of economy, and through the medium of the Society to bring together those who are concerned in the speedy solution of the problem. Some of the most important and practical appliances known to many who may visit the Exhibition will not be seen there, owing to the difficulties and disadvantages attendant upon the first efforts of a young Society scarcely known to the public.

The following was the original classification to which the council asked the attention of the exhibitors. No exhibitors have been named in classes 6 and 7; and 3 and 4 it has been found convenient to amalgamate.

(1). Appliances which may be adapted to existing steam furnaces, &c., whereby an improved combustion of the fuel is secured, and a direct diminution in the quantity required is effected.
(2). Appliances which may be adapted to existing steam boilers, &c., whereby the waste heat of the flue gases or of exhaust steam is utilised.
(3). Appliances which may be adapted to existing steam boilers, pipes, and engines, whereby loss of heat from radiation and conduction is prevented.
(4). Appliances which may be adapted to existing steam boilers and engines, enabling them with safety to realise the great economy resulting from the use of high pressure steam or superheated steam.
(5). New or improved furnaces (using solid, liquid, or gaseous fuel), boilers, and engines of all descriptions, specially adapted for the saving of fuel.
(6). Apparatus which, by producing a cheap and abundant gaseous fuel, will supersede the costly carriage of coal, obviate the present enormous waste attending its use in the solid form, and condense and save the valuable sulphur, ammonia, and other by-products of the distillation now injuriously affecting iron and other smelting processes, and in a vast number of operations discharged as poisons into the air.
(7). Apparatus or engines for obtaining power advantageously from heat through any other medium than steam.
(8). Natural and artificial fuels of all kinds.
(9). Coal cutting machines. Peat manufacturing machines.
(10). Domestic and other fires, stoves, ranges, and apparatus of all kinds (using coal, gas, or other fuel) for cooking, and for warming rooms and buildings.
(11). Mechanical or other arrangements for securing the delivery of proved weights of fuel to the domestic consumer.

Entering at the south door is seen a wooden model of Davey's Patent Differential Expansive Pumping Engine, 200-horse power, for the New Hartley coal-pit; the engine is intended to lift 1500 gallons of water per minute 420 feet high. This is exhibited by Hathorn, Davis, and Co., of Leeds.

On the right-hand side of the building the first object which engages our attention is Erskine's Patent Economiser. This consists of 10 horse-shoe pipes about 4 inches in diameter, and all connected; these are placed in the flue communicating with the chimney. The waste heat from the boiler fire encircles these pipes, and causes the water which flows through them to enter the boiler at a temperature of 280° F.; and as these pipes are liable to become covered with soot and dust, instead of having a scraper, as in many instances is done, a pipe about 2 inches in diameter passes through the entire length of the horse-shoes, which is perforated with holes about 6 inches apart. The pipes are allowed to get hot, and the steam is now blown on to them, which, according to the inventor's statement, effectually cleanses them. The advantages which Mr. Erskine claims are, that from the peculiar form of his economiser, it causes no diminution or obstruction to the draught in the flue. It maintains a thorough circulation of the water through all the tubes, thus preventing the accumulation of scale; it is easy of access to every part, so that if one of the pipes is injured it can easily be replaced.

Andrew Bell shows a fine set of spiral economisers; they have the exact shape of three condensing worms put together. Each worm consists of 70 feet of pipe, and a three-coil machine is sufficient for a 40-horse boiler. Mr. Bell has shown great ingenuity in the casting of these iron worms; it would not be an easy undertaking to cast the worms in one piece, in fact practically impossible. The spirals are cast in half circles, having a spigot and facit joint. The joints fit so well into each other, that the circle can be formed and lifted without the joints parting; moulding boxes are put round these joints, and hot metal run upon them, so that it forms a perfect spiral when they are all connected. This arrangement does away with all flange joints, so that no leaking can possibly occur, and also secures a perfectly smooth surface for the action of the scraper, which revolves, ascending and descending according to the spiral form of the coil. It is said that a saving of at least one day's consumption of fuel per week is effected. The water having a continuous circulation, all sediment is held in solution and passes through the coils, thereby avoiding deposit. Each coil is tested to a pressure of 300 lbs. per square inch before leaving the works. Economisers of various forms make a great show, and it is difficult to say which is the best.

Twibill, of Manchester, exhibit a fine perpendicular economiser, which consists of a collection of tubes set vertically in the flue. These tubes are tested to a pressure of 500 lbs. to the square inch. Some experiments were performed some time since after the heater had been in use for some time. The first test was taken at six o'clock on Monday morning; the temperature of the water in the pipes was 140° F. At four o'clock on the same day it had risen to 284° F., on Friday morning at six o'clock the temperature was 250° F., and at four o'clock the same day it had risen to 310° F.; and the average temperature of the water throughout the week was 273° F. An experiment was performed at Messrs. Romaine and Callender's mill, and the average temperature of the water was 295° F. The scrapers are peculiar to Twibill's machine; they meet round the tubes and have chisel edges, which, by a special arrangement, press against the tube, and actually cut off the soot and tarry matter which accumulates upon the pipes.

Green, of Wakefield, exhibit the finest vertical economiser; the joints of their economiser are all turned and bored socket-joints, "metal and metal" forced together by powerful machinery expressly adapted for the purpose. Their economisers are in operation to 65,000 boilers, representing 2,500,000 horse-power. There is one serious objection to these vertical economisers; that is, if a pipe in the centre burst it is not easy to get at it, and to replace it often involves a loss of several days, whereas in Erskine and Bell's, if one of the spirals get injured it is easily replaced without long stoppage of the works.

Nield's improved fuel economiser is on the same principle as Andrew Bell's. This economiser is arranged in sections, each section consisting of a number of cast-iron ring-shaped pipes, through which the water is caused to circulate. The inlet and outlet passages of each ring are close together; and as this is the sole joint, and the only fixed point in the ring, it is quite impossible that the expansion and contraction of the ring can affect the joint in any way; this is a very important advantage, and is peculiar to this economiser.

Robert and Joseph Ellis, of Liverpool, show some ingenious fire-bars, in which the water, before it enters the boiler, is made to traverse these bars, and is raised to a temperature of 300° F. There are many other appliances for heating the water before entering the boiler; there is the Paxman Water-Heater, in which waste steam from the engine is condensed, and so made to heat another supply of water, and the water is pumped into the boiler at a temperature of 200°.

Goodbrand and Holland show a coal-cutting machine. It is a 27 inch self-acting right or left hand coal cutter, constructed specially for the Wharncliffe Silkstone Coal Company to undercut their medium hard coal at bottom of seam.

Messrs. Ommanney and Tatham also have Winstanley's coal-cutting machine. This machine is designed for holing in mines which are worked on the wide work or long wall system. It is driven by compressed air, the pressure required being from 20 to 30 lbs. per square inch, according to the nature of the coal to be cut. The height of the machine is 22 inches, and the gauge of the wheels can be made to suit any ordinary colliery tramway. The cutter holes its own way into the coal, cutting from nothing up to 3 feet or more in depth, the thickness of the groove being 3 inches. The small coal made by holing represents only from 25 to 35 per cent of the quantity of small coal produced by hand holing. The average rate of holing in hard coal, with a pressure of 30 lbs. per square inch, is 25 yards per hour, including stoppages, and this may be considered to equal the work which would be done by at least thirty men in the same time.

Messrs. Hanworth and Horsfall exhibit a self-feeding smoke-burner and fuel-economising furnace. The drawback to it is the complicated arrangement for effecting the object. The bars are moved by egg-shaped wheels, which gives them a forward and backward motion, and the coal is allowed to fall upon them by means of a sloping plane.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, December 22nd, 1873.

Mr. Edward C. C. Stanford, F.C.S., President, in the Chair.

A paper, "*On Coloured Tapers,*" by Mr. James McFarlane, Assistant to the Professor of Chemistry, St. Andrews, was read. The author detailed a series of experiments which he had prosecuted for the purpose of determining the nature of the colouring matter in the green and red wax tapers. He distinctly ascertained that the former owed their colour to the presence of Scheele's green (arsenite of copper). Their average weight was 2 grms., and the average time occupied in burning was seventeen minutes. Guided by the colour and by the alliaceous odour evolved during combustion, he had no difficulty in pronouncing that arsenic was present; its presence was experimentally determined, and its quantity estimated to be 0·60 per cent of the taper, equal to 0·35 grm., or 5·43 grs. of arsenious acid—quite enough to poison two people if taken directly in the solid form. The red tapers weighed, on an average, about 8·94 grms., and burned seventeen minutes, leaving 3 milligrms. of ash totally devoid of metallic appearance. Mercury, existing as vermillion, was found by Reinsch's process, and its quantity was afterwards carefully determined. The amount of mercuric sulphide ultimately collected, washed, and dried, was 1·66 per cent. In one series of experiments, the following results were arrived at—white, yellow, blue, red, and green tapers being experimented upon:—

White.—Perfectly harmless; little ash.

Yellow.—Harmless; coloured with chromate of lead.; ash, metallic.

Blue.—Harmless; coloured with ultramarine.

Red.—Highly poisonous, containing 1·93 per cent of vermillion; the tapers very highly coloured; slight ash.

Green.—Poisonous; colour due to arsenic; metallic ash; quantity of arsenic not determined, but probably about 1 per cent.

These tapers burned, on an average, twelve minutes, and in number and quality were much superior to the first, which were of the spiral character. The table is a summary of the results of the examination of the spiral tapers (see next column).

The author afterwards proceeded to consider the effects arising, or which might arise, from the use of coloured wax tapers, and the inhalation of the vapours resulting from their combustion.

	Red.	Green.
Time occupied in burning	12 mins.	17 mins.
Weight	0·93 grms.	2 grms.
Percentage of wax	72·90	71·30
Percentage of wick	25·44	26·89
Weight of wax, per taper	24·85	22·53
Weight of wick, per taper	8·67	8·49
Percentage of arsenious acid ..	—	1·81
Percentage of vermillion	1·66 to 1·93	—

"*On Arsenical Papers.*" As being closely allied with the subject of the coloured tapers, the same author submitted a communication on arsenical papers, in the course of which he reviewed the theories and cases for and against the alleged unhealthiness of rooms papered with hangings having Scheele's green as one of their colouring matters. He mentioned several cases of severe illness, and even of death, distinctly traceable to the inhalation of the green arsenical compound used in the preparation of the cheaper kinds of paper-hangings.

An interesting discussion followed; one of the speakers was Mr. Patterson, public analyst, Greenock, who stated that he had found green papers in the shop-windows of that town having an extraordinary amount of Scheele's green, and that he had also found it in large quantity in the coloured air-balloons which are sold to children in the streets.

"*Anemometers for Flue-Testing.*" Mr. James Mactear, St. Rollox Chemical Works, Glasgow, submitted a short paper on this subject, and illustrated it by exhibiting and describing a number of instruments used in determining the rate of speed of gases in flues and chimneys, more especially those devised by Mr. Thomas Hoey, engineer, Glasgow; Mr. Swan, Newcastle-on-Tyne; and Mr. Fletcher, Inspector under the Alkali Act for the Western District of England. He also exhibited and described another interesting piece of apparatus devised by Mr. Fletcher. Its use is to obtain average samples of the gases in a flue or chimney. The arrangement consists of a fine aspirator, which is worked by the rush of air into the flue, which in its turn works a train of wheels, and puts in motion a small bellows, the action of which is to pump out slowly a portion of the gases, and draw them through the test-solutions. Its use is chiefly for testing hydrochloric acid gas in flues and chimneys, the quantity pumped out being registered by an index, and the amount pumped out in a given time being thus easily found.

NOTICES OF BOOKS.

An Easy Introduction to Chemistry. Edited by the Rev. Arthur Rigg, M.A. London, Oxford, and Cambridge: Rivingtons.

This work, based, as the Editor tells us in his preface, upon a "First Book of Chemistry" published in America by a Dr. Worthington Hooker, has a very distinctive character. Less formally and avowedly systematic than many introductory works, it shows a curious felicity in illustrating chemical truths by means of familiar facts and well-known incidents. Still a few errors have escaped the notice of the Editor, and may mislead his readers. Thus we find the statement that "it (potassium) is commonly kept in wood-naphtha, a liquid which happens to have no oxygen in it. The naphtha sold in oil-shops and used in lamps is made from coals; there is oxygen in this, and therefore potassium cannot be preserved in such naphtha. With wood-naphtha as a covering to keep out its great friend oxygen, potassium can be preserved pure." We cannot for a moment suppose Mr. Rigg ignorant of the facts that wood-naphtha in its purest state contains 50 per cent of oxygen, and that potassium is kept in native mineral naphtha.

Again we read that plants get from the ground all the nitrogen they need. The researches of some of the most eminent agricultural chemists have led them to the conclusion that whilst certain plants, such as wheat, derive all or most of their nitrogen from the soil, and require therefore azotised manures; others derive the bulk of their supply from the air, either in the form of ammonia, or, according to Ville, of free nitrogen. These flaws we consider all the more important from their occurrence in a book which we otherwise admire, and we hope to see them removed in the next edition. It would be difficult to name a work more calculated to foster a taste for the study of chemistry in the minds of the young.

Elderhorst's Manual of Qualitative Blowpipe Analysis and Determinative Mineralogy. Edited by H. B. Nason, Ph.D., and C. F. Chandler, Ph D.; fourth edition. Philadelphia and London: Zell.

It is fortunate that this work presents nothing calling for serious animadversion, since it would be difficult to find the responsible person. In addition to the names mentioned on the title-page we are told that the fifth chapter is a slightly modified translation of Laurent's "Analyse au Chalumeau," that the sixth is nothing but an extract from Prof. v. Kobell's treatise on the discrimination of minerals, and that for the materials of this compilation the author is principally indebted to the works of Plattner, Bezelius, von Kobell, Dana, and Mitchell. Under such circumstances, errors in the methods laid down are not to be anticipated. We think that in recommending coal-gas as the source of heat in blowpipe experiments, attention should have been called to the circumstance that its sulphur may simulate the presence of sulphur in the body under examination.

In his preface to the third edition Mr. Elderhorst states that he has "paid particular regard to the species of minerals occurring in the American Continent; for this reason many less important ores have found a place in the list to the exclusion of others, which, though more valuable, have not hitherto been found in America." This passage, we think, involves a grave error in principle. The author cannot know where his readers may be called upon to examine and distinguish minerals. Neither can he tell that some of the species omitted may not be discovered to-morrow in some portion of the American Continent. Would it not, therefore, be well to furnish the student with the information needed for their recognition? We should unhesitatingly condemn a work of this character, which "paid particular regard" to minerals found in the United Kingdom, the British Empire, or the Eastern Continent.

In the introduction the author makes a limitation which is questionable—"A knowledge of blowpipe operations is less valuable for the chemist by profession than for the mining engineer, the mineralogist, and the geologist." Is it not unwise for the chemist by profession to hand over any of his functions—to wit, the recognition and determination of any body soever—to outsiders?

Apart from these points, and from the indistinct character of the illustrations, we consider the work well-conceived and got up, and we hope it will contribute to the study of a department of chemistry which has been unfortunately neglected.

Preis Courant der Fabrik fur Alkohol Präparate. Von C. A. F. Kahlbaum. Berlin: Schlesische Strasse, 13 and 14.

A price list of chemicals derived from the alcohols arranged under the heads of the methyl, ethyl, propyl, butyl, amyl, and the aromatic series, with an appendix of promiscuous chemicals. For comparison we quote a few of the prices given:—Iodide of methyl, £2 5s. per kilo.; aldehyd (absolute), £1 4s. per kilo.; glycerin at 1·26, 1s. 10d. per kilo.; uric acid, 6s. per 100 grms.; tannin, 7s. 6d. per kilo. It is interesting to see how many substances, which but a short time ago were mere laboratory curiosities, have now become ordinary articles of commerce.

CORRESPONDENCE.

SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

Sir,—Being large consumers of sulphate of ammonia, we are often much inconvenienced by the wet muddy state in which this article is delivered; in by far too many cases manufacturers apparently pack it up, and send it off, direct from the draining-box, without further attempt to dry it. Of course, it is very desirable that sulphate of ammonia should be dry, and it seems strange that sulphate of magnesia and other salts of a similar nature should be dried with the hydro-extractor, while sulphate of ammonia, a much more valuable salt, should be sent into the market in such a crude unrefined state. It would be quite as easy to dry sulphate of ammonia by the hydro-extractor as it is to dry Epsom salts, and it certainly is as desirable that it should be so. Trusting that those alike interested in this matter may have their attention directed to it, and demand that this sulphate be sold and delivered in the same condition as other chemicals, viz., in a perfectly dry state,—We are, &c., J. B. S.

FILTERING APPARATUS.

To the Editor of the Chemical News.

Sir,—On procuring a copy of your work, "Select Methods in Chemical Analysis," immediately after its publication, and reading the description therein of Dr. Carmichael's filtering apparatus, I conceived that the use of an air-pump might be dispensed with, provided the pressure on the inside of the bulb were sufficiently diminished. This I accomplished by making a syphon with a very long limb and a short one; on the extremity of the latter is the bulb. The long limb is 39 inches, and the short one 9 inches, which is long enough to reach the bottom of the largest beaker; therefore the difference between the two is 30 inches, so that when the syphon is filled with water the pressure on the outside of the bulb, *a*, is greater than the pressure on the inside by the weight of a column of 30" of water = $\frac{1}{13\cdot2}$ atmospheres = 1·1 lbs. per square inch. The little stopcock, *b*, is useful, for, when shut, the apparatus remains full of water, ready for use. This simple apparatus I find works very well, and filters rapidly, provided the precipitate is allowed to settle well before introducing the bulb into the liquid to be filtered; and its advantages cannot be over-estimated in cases where large quantities of liquid require to be filtered, because when once in operation—with the paper nearly, but not quite, touching the settled precipitate, and a vessel large enough placed to receive the filtrate—the filtration goes on steadily, without requiring any attention, and the precipitate is left in the bottom of the vessel almost dry. By stirring this well with water or other washing solution, allowing to settle, and again filtering, the precipitate can be much more thoroughly washed than on an ordinary filter. For the last washing, the precipitate is transferred to the porcelain or platinum capsule in which it is to be weighed, and the water filtered off from this in the same way.

These syphons are easily fixed for use by causing them to slide between two clamps, one above and one below the stopcock, which are fastened to two narrow shelves fixed against the wall, the upper of which serves to hold the vessels containing the solutions to be filtered. I have a set of six so arranged, with a space of about 6" between each two. By turning round the bulbs of any two towards each other, they meet, and can both be introduced into the same vessel, so as to filter by two syphons, when necessary, instead of by one.

Referring to J. B. Cooke's filtering apparatus, as described in Chemical News, vol. xxvii., p. 261, it may be infinitely improved by substituting the above-described syphon, cut off at *c*, for the straight tube, the small disc of paper replacing the carded cotton, by passing the end *c* through the stopper of the flask; the advantage being in this case that the flask remains in its upright position, and the weight of ash added to the precipitate, instead of being 100 grs., as in the case of cotton in Cooke's apparatus, will only be about 0·004 gr. It is obvious that the power of the syphon may be increased by increasing the length of the long limb.

Hoping the above may be found worthy of insertion in your valuable journal,—I am, &c.,

John F. Kerr, F.R.S.S.A.,
Engineer to the Coppo Gas Company.

Copiapo, Chili, S.A.,
July 21, 1873.

ABNORMAL QUANTITY OF CREAM FOUND IN SOME MILKS.

To the Editor of the Chemical News.

Sir,—Several instances are on record of milks analysed by the Public Analysts yielding abnormally large quantities of cream. Thus three samples, which recently came under my notice, gave 17, 24, and 30 per cent of cream respectively; the natural average being 10 per cent. The vendor of such milks has generally been looked upon as a would be "sly dog," who was under the impression that though he had surreptitiously added a little cream to the sample sold for analysis, the analyst would think only that praise was due to the tradesman who sold such remarkably good milk. I am inclined to think, from a proved case in my own district, that such an individual is maligned. Going further; probably some convictions have ensued, and fines been inflicted for the sale of milk, certified by the analysts to have been "skimmed," or to have been adulterated with water; when, in fact, the vendor has been guiltless of any fraud whatever in the matter.

Suppose one of those large cans filled with new milk, just arrived from the country, to stand for a couple of hours or so in the shop of the retailer; someone goes—it may be an inspector—and asks for a pint of milk. The can is opened, a measure plunged in, and the required quantity withdrawn. The sample so taken will contain an undue proportion of cream; while, if the same process of "baling" out be continued, by the time the can is nearly empty, the remaining quantity of milk will be practically "skimmed." Here then the "early birds" will have got all the cream, while the late ones have scarcely any, and if one of the late samples be submitted officially for analysis, a certificate adverse to the honesty of the milkman may be the result.

Of course it is evident that the persons selling the milk should stir the whole well together before taking any from the bulk; doubtless most of those persons do so, but that some—at any rate occasionally—do not I consider an established fact, their having "got into trouble" being a result of their carelessness,—I am, &c.,

Charles H. Piesse.

Utilisation of Waste Steam.—By the invitation of His Grace the Duke of Sutherland, a number of gentlemen met on Wednesday, the 28th ult., at Stafford House, to see exemplified Mr. J. Berger Spence's "steam-regenerating principle." The invention consists in passing steam at ordinary atmospheric pressure into a solution of caustic soda, which is thereby raised to its own boiling-point. It is proposed to use the heat thus developed to generate steam, the waste steam from an engine-boiler being employed in the first instance to heat the caustic soda. Mr. Spence showed that the effect was absolutely produced by raising a solution of caustic soda to a heat considerably over 212° by means of a jet of steam, but he stated that he had not yet worked out practical details as to the employment of the idea, though he exhibited a sketch of an arrangement of boilers which he considered might render it available.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

OTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 22, 1873.

Fermentation: Observations on the Subject of the Procès Verbal of the Last Session.—A continuation of the controversy between M. L. Pasteur and M. A. Trecul.

Chemical Composition of Certain Vegetable Parenchyma.—M. Maudet.—This paper treats of certain interesting phenomena in vegetable physiology. The author finds that the chemical actions which transform fibrose or medullose into cellulose are precisely those which produce the alterations or transformations of the epiangiotic bodies, and the pectic compounds which accompany these kinds of cellulose in the vegetable tissue. May we not infer that this fibrose and medullose are cellulose united, more or less intimately, by capillary attraction to the epiangiotic and pectic bodies?

New Researches on the Preparation of Kermes; Action of Alkaline Carbonates, and Alkaline Earthy Bases, on Sulphide of Antimony.—M. A. Terreil.—The author finds—That the preparation of kermes in the moist way can only be effected with carbonate of soda. That in the dry way the carbonate of potash is more productive than the carbonate of soda. That the carbonate of potash in the moist way has no action upon the sulphide of antimony, and that this character may serve as a test for showing the presence of soda in carbonate of potash. That the hydrate of lime attacks sulphide of antimony in the moist way, whilst the hydrates of baryta and strontia are without action upon it.

Deperdition of Magnetism.—M. Jamin.—The common idea is that, at each temperature, *t*, steel takes a certain magnetisation, which is less as *t* is higher, and which it retains on cooling. This is not correct. M. Jamin placed a bar, heated in a sand-bath, so as to receive the blue colour of springs, in a bobbin traversed by a current, and retarded its cooling (by a suitable arrangement). The steel took somewhat less magnetism than if it had been cold. Then he broke the circuit, and, on examining the remanent magnetism with a proof contact, found it much greater than the bar would retain if first cooled (109 grms. instead of 54). Thus the coercitive force does not diminish with heating, but increases. But if the force of detachment be again measured minute by minute it is found to decrease, at first very rapidly, then less so, till in a quarter of an hour it has quite disappeared; and this, whether the bar be kept hot, or allowed to cool naturally. The transition is almost continuous from total magnetisation to remanent, which in time descends to zero. Now re-heat the bar, but to a less temperature. Its total magnetisation (while the current passes) is greater than in the former case; but immediately on breaking the remanent magnetism is less than in that case; on the other hand, it disappears less quickly, and never entirely. Again, begin without heating the bar. The total magnetism is still greater; the remanent (on breaking) still smaller, and invariable with the time.

Note on Magnetism. (Continued.)—M. Gaugain.—A singular fact was observed. When one has magnetised an iron bar as strongly as it is possible to do so with a current of given intensity, the magnetisation may be considerably increased by using currents of the same direction, but of less intensity. This, however, depends on the mode of detaching the armature after interruption of the current; in these cases it was detached by a sudden movement at right angles to the polar faces; if it is detached by sliding along the faces, the feebler currents do not add to the magnetism developed by the stronger initial current. M. Gaugain considers the detaching of the armature weakens the magnetism; and this, through a shaking (*enbranlement*) of the molecules of iron, which diminishes the coercitive force. He works out a hypothesis of these and other phenomena.

On Phenomena of Gaseous Thermo-Diffusion produced in Leaves, and on consequent Circulatory Movements in the Act of Chlorophyllian Respiration.—M. Merget. (Extract).—When a leaf of *Nelumbium*, with its central concavity under water, is exposed to the sun, bubbles arise from the moistened surface; they cease on complete immersion of the limb. M. Merget found the gas to be atmospheric air, and attributing its production to the sun's heat-rays, he obtained the same phenomenon with an obscure source of heat. The difference of temperature between the exposed parts of the limb and the part protected by the water causes issue of gas from the latter; and for this to rise, spite of the hydrostatic pressure, there must be an impulsive action from the surrounding heated air. Then, if one heat the water on the leaf, so that the temperature becomes uniform, the emission should be stopped; it was so. Also, bubbles on the point of leaving the leaf could even be made to disappear by re-absorption, on hot water being added. Another experiment was, to connect the petiole with a water manometer, and heat equally the upper surface of the limb. The manometer was depressed, indicating a compression of air in the lacunæ, &c. And on removing the manometer, and dipping the petiole end in water, bubbles of gas rose from this, and continued to do so, in some cases, for entire days. There must evidently have entered, by the limb, a volume of air equal to that which issued. This takes place by the stomates; the stoppage of these stopped the liberation of gas. Other gases (in which the leaf was put) were found capable of diffusion, thermo-dynamically, through the limb. The author thinks these are not vital, but purely physical phenomena—of the kind lately studied by MM. Feddersen and Dufour. They probably occur, too, in all plants; a circulatory gaseous current passing from the green parts, which respire, to those which do not respire, while there is a correlative movement of respiration by the former and of expiration by the latter. In aquatic plants the circulation is more extensive.

Moniteur Scientifique, du Dr. Quesneville, December, 1873.

On Plumbago, Graphite, and its Uses.—This paper, a commentary upon an American pamphlet by Mr. Orestes Cleveland, has no direct chemical interest.

Nature of Chloride of Lime (Hypochlorite of Lime).—M. Goepner.—A voluminous paper, which, as the author threatens, is merely the introduction to more developed details to be given in a memoir in course of preparation. The following points are stated as requiring further elucidation:—The chemical composition of chloride of lime, which is not constant; the variable quantities of chloride of calcium and of quick-lime, the origin and the function of which are still doubtful; the question whether preformed hypochlorous acid exists in the chloride. It is well known that chlorides of lime made by one and the same procedure are never identical, their value in active chlorine, capable of bleaching, requiring to be specially determined by analysis in each case. This diversity does not spring from subsequent decomposition, but may be traced when the samples are first drawn from the chambers. On the small scale, these divergencies are still more striking, no two of the samples made by the author in the course of his researches being alike, though all the circumstances appeared identical. The quick-lime employed in the manufacture is always more or less contaminated with carbonate of lime, and the chlorine gas is mixed with variable quantities of hydrochloric and carbonic acids. The author prefers the analytical method of Otto, which, as he finds, gives results closely agreeing with those of Penot's method.

On Antimony Blue.—Ch. Krauss.—The author proves satisfactorily that this supposed new colour is merely a variety of prussian blue containing no antimony.

Phospho-Tungstic Acid as a Precipitant for Organic Bases.—E. Scheibler.—The bitungstate of soda is dissolved in boiling water with half its weight of phosphoric acid (sp. gr., 1·13), and kept in ebullition for a few minutes. After standing for a few days, the solution deposits fine crystals of a soda salt containing both tungstic and phosphoric acids. Chloride of barium is added to the solution of this salt, the precipitate is washed with hot water containing a little hydrochloric acid, the baryta is removed by means of sulphuric acid, and the filtrate is evaporated, when the phospho-tungstic acid separates out in splendid octahedral crystals. If the monotungstate of soda is used instead of the bitungstate, and the operation conducted otherwise in the same manner, a phospho-tungstic acid is obtained, differing slightly, and crystallising in cubes. These acids, especially the latter, throw down all the organic bases perfectly, even from very dilute solutions. They are very valuable for the first separation of organic bases, but cannot be employed for their final purification, as they precipitate at the same time colouring matters, peptones, &c. The solutions from which the bases are to be thrown down must be previously acidulated with sulphuric acid.

Liebig's Annalen der Chemie und Pharmacie.
November 20, 1873.

Chlorides and Oxychlorides of Sulphur.—A. Michaelis.—The author describes the preparation and properties of the tetrachloride of sulphur. Passing over the hypothetical matter, of which this paper chiefly consists, the actual results may be summed up as follows:—At −22°, S_2Cl_2 takes up chlorine corresponding to the formula SCl_4. The product thus obtained has the property of a definite chemical compound of entering into double decompositions. The dissociation of SCl_4 increases very rapidly with the rise of the temperature; the dissociation of SCl_2 is far less rapid.

Nature and Constitution of Tannic Acid.—Hugo Schiff.—The author, after summing up the results of earlier chemists, examines the action of oxychloride of phosphorus upon gallic acid. He declares that tannic acid is not a glucoside, and views it as a "first anhydride" consisting of two molecules of gallic acid, and consequently as digallic acid. By the action of arsenic acid, gallic acid is almost entirely converted into tannic acid, without being reduced to arsenious acid.

Correction regarding Carbazolin.—C. Gräbe.—The author corrects certain formulæ in his paper (clxiii., 356).

Capronic Acid contained in the Crude Butyric Acid of Fermentation.—Adolf Lieben.—The author compares the capronic acid obtained by fermentation with that produced synthetically. The differences, he thinks, are the result rather of an impurity in the former kind of acid than a proof of the existence of two isomeric acids.

On the Capronates (Fermentation).—F. Kottal.—In this paper we find an account of the composition and properties of the capronates of lime, baryta, strontia, cadmium, and zinc. None of these salts were obtained in well-defined crystals.

Condensation-Product Obtained from Oxybenzoic Acid.—L. Barth and C. Senhofer.—The new substance, which the authors have named anthraflavon, is, like anthrachrysen, a derivative of anthracen. It cannot be used as a dye-ware, since it produces upon mordanted cloth only a faint yellowish-red shade. Anthrachrysen also does not yield a full madder-red shade, but only a dull yellowish red with a grey cast. Anthraflavon has feebly acid properties, and its saline compounds are not readily obtained in a state of purity.

Phenol-Trisulphuric Acid.—C. Senhofer.—This acid, according to the author's analysis, contains:—

Carbon	18·11
Hydrogen	3·27
Sulphur	24·18

and may be represented by the formula $C_6H_6S_3O_{10} + 3\frac{1}{2}H_2O$. At 105° it suffers incipient decomposition. The author has examined the phenol-trisulphates of baryta, potassa, silver, lead, soda, cadmium, copper, and ammonia.

Orthoxylol Prepared from the Liquid Brom-Toluol Formed from Toluol and Bromine.—Paul Jannasch and H. Hübner.—Orthoxylol and ortho-toluylic acid were obtained by the authors from the mixture of monobromtoluols produced by the mutual action of bromine and toluol.

On Dichlor-Glycid.—Ad. Claus.—The formula of this compound in a state of purity is $C_3H_4Cl_2$. It is composed of—

Carbon	32·4
Hydrogen..	3·6
Chlorine	64·0

Its specific gravity is 1·21. It is soluble in alcohol and ether, but insoluble in water.

Action of Cyanide of Potassium on Dichlor-Glycid.—Ad. Claus.—The products of this reaction are oxycrotonic acid and tricarballylic acid.

On Œnanthylic Acid and on Normal Heptylic Alcohol.—Harry Grimshaw and Carl Schorlemmer.—The authors examine the œnanthylates of soda, potassa, baryta, lime, zinc, lead, copper, and silver.

On Trimethyl-Acetic Acid.—A. Butlerow.—The author describes his attempts to find a more productive method of preparing the above-mentioned acid. He finally selects as his starting-point the action of the double cyanide of mercury and potassium with iodide of butyl.

Dichlor-Propionic Ether Prepared from Glyceric Acid.—MM. Werigo and Werner.—The normal action of 3 equivs. of PCl_5 on 1 equiv. of glyceric acid yields a non-crystalline chlor-anhydride, which, in accordance with existing analogies, yields with water dichlor-propionic acid, and with alcohol dichlor-propionic ether. This ether, according to the manner of its decomposition and the nature of the bases thereby employed, yields dichlor-propionic acid, chlor-acrylic acid, or an acid perhaps having the composition of chlor-lactic acid.

Contributions to the Knowledge of Citric Acid.—MM. Hermann and Kämmerer.—The authors, although their researches are not completed, have come upon a number of combinations of the citrates previously unimagined. They have examined the citrates of the alkalies, of the alkaline earths, of zinc, cadmium, iron, copper, lead. They deny that an acid isomeric with the citric can be obtained by the method indicated by Rochleder.

On Citraconate of Baryta.—MM. Hermann and Kämmerer.—A short notice on the preparation and properties of this salt.

Theory of Dissociation.—A. Horstmann.—A lengthy mathematical paper not adapted for abstraction.

A Correction.—E. Linneman.—A short controversial notice in reference to a paper by Butlerow (vol. clxviii., p. 143).

University of Oxford.—Three courses of lectures will be continued during this term—One by the Professor, Dr. Odling, F.R.S., on Organic Chemistry (in detail); one by W. W. Fisher, M.A., on Organic Chemistry (in outline); and one by W. F. Donkin, M.A., on Elementary Inorganic Chemistry. There are also two courses of instruction in practical chemistry—one in quantitative analysis, the other in elementary manipulation for beginners. The Demonstrators are Messrs. Fisher, Donkin, and John Watts, D.Sc.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of peat for fuel, and in apparatus for the same. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Jean François Félix Challeton, Paris.) March 14, 1873.—No. 945. This relates—(1). To an improved treatment of peat, the ulmine contained in which is first extracted, and after a preliminary fermentation is disintegrated by means of crushers or stampers. It then undergoes a rasping treatment, and is next sifted to separate the lighter substances. An arrangement of apparatus is described for carrying out the above operations. Steam is next employed to decompose the alkaline ulmates and set at liberty the organic mucilaginous matter of bog plants. After settling, a crystallised ulmine is obtained of considerable density, forming a fuel of standard quality. (2). An oven of special construction is also described for converting the crystallised ulmine into coke or charcoal, the material being supplied in a continuous manner, and subjected to different temperatures (according to the degree of carbonisation required), during its progress through the apparatus, which is heated by the gaseous products of the decomposition, the oils, pitch, and paraffin being also separated in condensing apparatus forming part of the oven.

Improvements in the manufacture of gas for illuminating and other purposes. Isham Baggs, of High Holborn, in the county of Middlesex, practical chemist. March 20, 1873.—No. 1046. Mixtures of hydrogen and carbonic acid gases, or of hydrogen and carbonic acid gases and carbonic oxide, however the same may have been produced or eliminated, through a heated "scrubber," the latter being placed vertically and filled with pieces of charcoal, coke, iron, or other suitable substances in such a manner that the carbonic acid which passes by filtration through the heated mass is converted into carbonic oxide, whilst the hydrogen and carbonic oxide (when the latter is contained in the mixture) pass by unaffected in their chemical character. Instead of merely purifying the gas as above described, the generation and purification thereof in one process is preferred. Two or more vertical scrubbers charged with suitable carbonaceous materials are arranged as a series, and the whole heated to a high degree. Steam is admitted to the first of the series, alternately ascending and descending, or *vice versâ*, through the same. The scrubbers are heated, by preference, by means of the hot blast.

Improvements in manures. Peter Jensen, engineer and patent agent, 89, Chancery Lane, Middlesex. (A communication from Egmund Julius Erichsen, of Copenhagen). March 21, 1873.—No. 1055. Mixing superphosphate manures with silicate of soda or silicate of potash, or mixtures of them, in order to dry off the manures.

Improvements in the preparation of powders for the destruction of animal and vegetable parasites, applicable also as disinfectants and deodorisers. Charles Roberts, F.R.S.C., 2, Bolton Row, Mayfair, Middlesex. March 26, 1873.—No. 1121. This Provisional Specification describes impregnating powdered substances with sulphurous acid.

Improvements in the manufacture of pyroxyline to be employed as an explosive material and in the manufacture of collodion; also in the treatment thereof when it is to be employed in the solid state for dental and for other purposes. Dana Bickford, New York, but at present of 35, Southampton Buildings, Middlesex. (Partly a communication from Dr. Spooner, New York, and partly a communication from the Pyroxyline Manufacturing Company, Boston, Mass.) March 29, 1873.—No. 1170. The invention consists in the manufacture of pyroxyline from the esculapius weed to be employed as an explosive material, and in the manufacture of collodion; also in the treatment thereof when it is to be employed in the solid state for dental and for other purposes.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 9.—Medical, 8.
— London Institution, 4.
— Geographical, 8.30.
TUESDAY, 10.—Royal Institution, 3. Prof. Rutherford, M.D. "On Respiration."
— Civil Engineers, 8.
— Anthropological, 8.
— Photographic, 8. Anniversary.
WEDNESDAY, 11.—Society of Arts, 8.
THURSDAY, 12.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8.30.
— Royal Society Club, 6.
FRIDAY, 13.—Royal Institution, 8; Weekly Evening Meeting. Dr. Doran, "On the Opponents of Shakespere", 9.
— Astronomical, 3. Anniversary.
— Quekett Microscopical Club, 8.
SATURDAY, 14.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

UNIVERSITY COLLEGE, LONDON.

Organic Chemistry.—Professor Williamson's Course of Lectures on this subject will begin on Monday, February 9th, and will occupy about six weeks, the class meeting every week-day, except Saturday, from 11 to 12. Fee, £2 2s.

ANALYTICAL CHEMISTRY is taught in the Birkbeck Laboratory, which Students may enter at any period of the session.

JOHN ROBSON, B.A., Secretary to the Council.

Professor Tennant's Lectures on Rocks and METALLIC MINERALS at King's College are given on Wednesday and Friday mornings from 9 to 10 o'clock, and on Thursday evenings from 8 to 9. The lectures commenced Thursday, January 22nd, and will be continued to Easter.

PRIVATE INSTRUCTION in GEOLOGY and MINERALOGY can be had by Professor TENNANT at his residence, 149, Strand, W.C., by those unable to attend public lectures.

TEXT-BOOKS OF SCIENCE, EDITED BY T. M. GOODEVE M.A., AND C. W. MERRIFIELD, F.R.S.

On Saturday, February 7, will be published, in small 8vo., cloth, with numerous Woodcuts, price 3s. 6d.

Organic Chemistry, Introduction to the Study of; the Chemistry of Carbon and its Compounds. By HENRY E. ARMSTRONG, Ph.D., F.C.S., Professor of Chemistry in the London Institution.

London: LONGMANS, GREEN, and CO., Paternoster Row.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 742.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

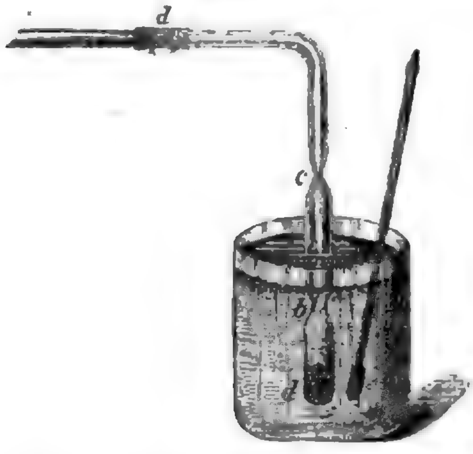
(Continued from p. 66).

Oxalic Acid.

Commercial purified oxalic acid is gently heated in a flat dish until the water of crystallisation is removed. Bibulous paper is then placed over it, a paper cap over that, and the heat is increased until the oxalic acid sublimes. The sublimed crystals are removed from the inside of the paper cap, and introduced into the lower portion, *a*, of the glass apparatus shown in Fig. 9. The tubes are contracted at *b* and *c*, and the end *d* is connected by means of an india-rubber connector with the Sprengel pump. The air is now completely exhausted from the apparatus, and it is immersed in a paraffin-bath to a little above the first contraction, *b*; a thermometer is also immersed in the bath.

The temperature is first raised to 200° F., and the exhaustion continued until all moisture disappears from the inside of the tube. The bath is then gradually raised to 250°, and kept at that temperature till the oxalic acid has risen in vapour and condensed in the wide portion of the tube between *b* and *c*. The paraffin-bath is then taken away, and when the tube is cold it is removed from the pump by applying a blowpipe-flame to the contraction *c*; this being repeated at *b*, leaves the sublimed oxalic acid perfectly pure in the bulb *b c*, and in a vacuum.

Fig. 9.



In this apparatus oxalic acid commences to sublime below 200° F. If the temperature of the paraffin-bath be kept below 278° F., no permanent gas is evolved, and no formic acid is obtained; above that temperature, the barometer-guage of the pump commences to sink; but the mercury descends very slowly until 330° is reached, when the decomposition of the oxalic acid into formic and carbonic acids becomes more rapid.

Sulphuric Acid.

After many attempts to prepare sulphuric acid free from arsenic by the distillation at a red heat of alkaline bisulphates, by dissolving sulphuric anhydride in water, and by decomposing sulphate of silver with sulphuretted hydrogen, I finally adopted Bloxam's method of preparing it by means of sulphurous and nitrous acids (*Journ. Chem. Soc.*, vol. xv., p. 52).

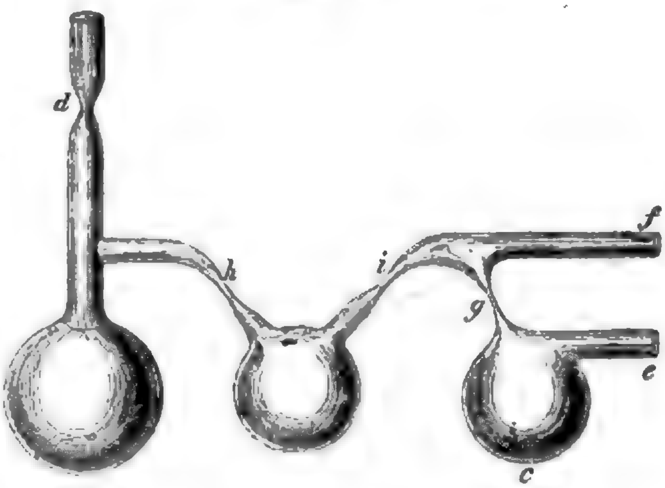
The sulphurous acid is evolved from well-crystallised sulphite of sodium by the action of sulphuric acid, keeping the temperature as low as possible. The current of gas is first passed through a washing-bottle of water containing a little oxide of silver in suspension (which becomes converted into sulphite of silver, and then into a mixture of sulphate of silver and metallic silver), then through two U-tubes filled with small pieces of pumice-stone moistened with water. The pumice-stone should be previously purified from chlorides and fluorides by Stas's method of igniting it twice with sulphuric acid.

The nitrous acid is prepared by gently heating together nitrate of potassium, ferrous sulphate (both purified by repeated crystallisation), and dilute sulphuric acid.

The sulphurous acid and nitrous acid are conducted simultaneously by tubes into a large glass globe, a third tube serving for the introduction of steam. The three tubes pass into the globe through a glass plate in which three holes have been perforated. The glass plate and mouth of the glass globe are fitted to each other by grinding. No lute being used, sufficient air finds its way into the globe to keep up the reaction. By regulating the ingress of nitrous acid, of sulphurous acid, and of steam, the operation can be carried on continuously for many hours.

The condensed liquid is next introduced into an apparatus blown from hard German glass, as shown in Fig. 10. *a*, *b*, and *c* are three bulbs about 3 inches diameter. The dilute sulphuric acid is introduced into the bulb *a* by means of the neck *d*, which is then sealed before the blowpipe at the contracted part. The end of the tube *e* is then connected with the Sprengel pump, the end *f* temporarily stopped up, and the whole is exhausted. The bulb *b* is immersed in a water-bath kept at the boiling-point, and, *a* being gently heated, the excess of water in the sulphuric acid goes off, and partly condenses in the bulb *c*, which is kept cold, and partly becomes carried down through the pump by the falling mercury.

Fig. 10.



Concentration of the acid proceeds rapidly; and as soon as all excess of water has been thus eliminated, and the gauge of the pump shows that only aqueous vapour is present, the bulb *c*, containing water, is removed by applying a blowpipe-flame to the contracted portion of the tube *g*. Air is now admitted, the tube *f* is connected with the Sprengel pump, and exhaustion again proceeded with. The bulb *b* is now kept cool, and the bulb *a* heated in a sand-bath. The atmospheric pressure must not be altogether removed, or the bumping of the acid in *a* will be very violent. If the exhaustion is such that the mercury in the gauge stands at about 15 inches, the oil of vitriol distils quietly from the bulb *a* to *b* without bumping; but if the exhaustion is raised to above 16 inches, the ebullition becomes percussive. When most of the acid has distilled over into *b* the source of heat is removed, the mercury in the pump is again allowed to run until a vacuum is produced, and the bulb *b*, containing pure distilled sulphuric acid, is sealed up and removed by the application of a blowpipe-flame to the contracted portions of the tubes *h* and *i*.

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* A Paper read before the Royal Society June 20, 1872.

Carbonic Acid.

Calc-spar is dissolved in pure hydrochloric acid. An excess of the spar is added, and the solution warmed; to it is added lime-water made from pure or nearly pure lime, until the solution is alkaline to test-paper. This solution is filtered, and after heating it to at least 160° F., precipitated with carbonate of ammonium.[*] The carbonate of calcium thus precipitated is thrown on a filter and well washed with pure water. Thus prepared, the carbonate of calcium is a dense powder and perfectly pure; or, if it contain any impurity, it will be a trace of carbonate of barium or strontium, which in no way interferes with its use in preparing carbonic acid.

The dense granular carbonate of calcium is then strongly compressed in a steel diamond mortar into the form of coherent lumps. These lumps are introduced into a Wolff's bottle, and pure oil of vitriol poured over them. A continuous and not too rapid evolution of carbonic acid commences, and is continued for some time. When the disengagement of gas becomes sluggish, a few drops of water restore the action. Large bottles must be used for this operation to avoid the inconvenience of the foaming to which the acid is liable.

The carbonic acid is washed by passing through solution of sulphate of silver containing carbonate of silver in suspension to the consistency of thin cream, and it is then passed through a U-tube containing purified pumice-stone moistened with oil of vitriol.

Ammonia.

Ammonia is prepared in two ways:—

(1). Nitrate of potassium heated to incipient decomposition, and then crystallised three times from pure water, is dissolved to saturation in water, and put into a retort. Sodium amalgam containing about 1 per cent of sodium is then added, and the whole allowed to stand in a cool place for twelve hours. Gentle heat being now applied to the retort, ammonia (from the reduction of the nitric acid) is driven over with the first portions of water, and is condensed in a receiver cooled with ice. The temperature of the liquid in the retort is not allowed to rise to the point of ebullition, and the operation is stopped when one-fourth of the liquid in the retort has distilled over.

(2). Ammonia is also prepared by a method recommended by Professor Stas. Nitrite of potassium is mixed with strong solution of caustic potash, and the liquid poured into a large glass balloon containing a mixture of zinc (free from carbon)[†] and iron wire, which has been first oxidised by heating in the air and then reduced by hydrogen. After standing for seventy-two hours, the liquid is decanted from the residue into a retort, which is then gently heated on a sand-bath. The arrangement for condensing the ammonia consists of two flasks fitted up as Wolff's bottles containing pure water. The distillation is effected very slowly below the boiling-point of the liquid, and the condensers are cooled with ice.

Hydrogen.

The method pursued in the preparation of pure hydrogen is as follows:—The gas is generated in one of a series of Wolff's bottles by pouring warm caustic potash over a mixture of granulated zinc and iron scraps. The gas thus generated (the method is thus due to Runge, *Pogg. Ann.*, vol. xvi., p. 130) is inodorous. It is next passed into another Wolff's bottle containing protochloride of tin; then through tubes containing pumice-stone moistened with a concentrated solution of pyrogallic acid in caustic potash, and again through tubes containing pumice moistened with sulphuric acid, the object in passing the gas through the protochloride of tin and through the pyrogallic acid being to remove the oxygen diffused into the apparatus from the atmosphere.

Thallium.

It may not be out of place here to note the most usual sources of thallium as it is ordinarily prepared.

Thallium is a very widely distributed constituent of iron and copper pyrites. Upon examining a large collection of pyrites from different parts of the world, it was found present in more than one-eighth. It is not confined to any particular locality. Amongst those ores in which it occurs most abundantly (although in these cases it does not constitute more than from the 100,000th to the 4000th of the bulk of the ore), may be mentioned iron pyrites from Theux, near Spa in Belgium, from Namur, Philipville, Alais, the south of Spain, France, Ireland, Cornwall, Cumberland, and different parts of North and South America; in copper pyrites from Spain, as well as in crude sulphur prepared from this ore; in blende and calamine from Theux; in blende, calamine, metallic zinc, sulphide of cadmium, metallic cadmium, and cake sulphur from Nouvelle-Montagne; in native sulphur from Lipari and Spain; in bismuth, mercury, and antimony ores, as well as in the manufactured products from these minerals (frequently in so-called pure medicinal preparations of these metals); in commercial selenium and tellurium (probably as selenide and telluride).

Thallium is likewise frequently present in copper and commercial salts of this metal. In Spain a very impure copper is prepared in the following way:—Copper pyrites is allowed to oxidise in the air, and the resulting sulphate of copper is washed out; scrap iron is now placed in the liquid, which causes the copper to precipitate in the powdery state. The metal is then collected together, dried, strongly compressed, and heated to the melting-point. It is brought over to this country in the form of rectangular cakes, weighing about 20 lbs. each, and is called "cement copper." The sulphide of thallium, oxidising to sulphate along with the sulphide of copper, is washed out by the water, and precipitated with the copper by the iron. The two metals alloy together.

Thallium is present in tolerable quantity in lepidolite from Moravia, and in mica from Zinnwald. It has likewise been found in the deliquescent "sel à glace" from the mother-liquors of the salt-works at Nauheim. This consists of a mixture of the chlorides of magnesium, potassium, and sodium, with relatively considerable quantities of chlorides of rubidium and cæsium, and sensible traces of chloride of thallium. Thallium is also met with in the mother-liquors in the sulphate of zinc works at Gozlar, in the Harz.

Nordenskjöld has found in the copper mine of Skrikerum, in Norway, a native selenide of copper, silver, and thallium, containing about 18 per cent of thallium. It occurs in the form of lead-grey compact masses, having the hardness of copper glance and a sp. gr. of 6·9. This mineral has been named *Crookesite* by its discoverer. From the general association, of selenium, copper, silver, and thallium in iron and copper pyrites it is probable that the thallium is here present in the form of Crookesite disseminated through the mass.

The optical process of detecting thallium in a mineral is very simple. A few grains of the ore are crushed to a fine powder in an agate mortar, and a portion taken up on a moistened loop of platinum wire. Upon gradually introducing this into the outer edge of the flame of a Bunsen's gas-burner, and examining the light by means of a spectroscope, the characteristic green line will appear as a continuous glow, lasting from a few seconds to half a minute or more, according to the richness of the specimen. By employing an opaque screen in the eyepiece of the spectroscope to protect the eye from the glare of the sodium line, thallium may be detected in half a grain of mineral, when it is present only in the proportion of 1 to 500,000. The sensitiveness of this spectrum reaction is so great that no estimate can be arrived at respecting the probable amount of thallium present.

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[*] This precaution, which was first suggested by Professor J. Lawrence, of Louisville, must not be overlooked, as it is desirable to obtain the precipitated carbonate of calcium as dense as possible. If the carbonate of ammonium be added to the cold solution, the precipitate, at first gelatinous, will ultimately become much more dense and settle readily; the same is true if the mixture be heated after the addition of the carbonate of ammonium; but in neither case will it be as dense as when the carbonate is added to the hot solution of chloride of calcium.

[†] Zinc is obtained free from carbon by fusing it with a mixture of carbonate of sodium and nitre.

Many samples of commercial sulphuric acid and yellow hydrochloric acid contain thallium. The source in these cases is evidently the pyrites used in the sulphuric acid works.

(To be continued.)

THE CHEMICAL CONSTITUTION OF CITRIC ACID AND ITS NUMEROUS DERIVATIVES,

CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from page 43).

PART II.

On the Effects of Heat upon the Ordinary Citrate of Water, as also on the Effects of Oxidising and Reducing Agents upon the three Pyro-Citric Isomerides.

(1). Let us, in the first place, inquire into the effects of heat upon the ordinary citrate of water. When this compound is heated up to a certain point, it splits up into to 2 molecules of water and the so-called aconitate—

$$\begin{array}{ll} \gamma) & 2C_6; \qquad H_2O_2. \qquad H_2O_2. \quad H_2O_2. \quad H_2O_2. \\ \alpha) & 2(C_2:C_2:C_2);\overline{H_2O_2:2H;2C_2O-2C_2O_3-2C_2O_3,} \\ \beta) & 2(C_4:C_2); \end{array}$$

which, by its formula, ought to occur in three isomeric forms, and is thus shown to be identical with the *d* orthocitrate of the third scheme. When the aconitate is heated in its turn it resolves itself into carbonic acid and a mixture of two isomeric water-salts, which correspond to the itaconic and citraconic acids of our handbooks; if we add to these a third isomeride, which passes under the name of mesaconic acid, the whole of these three varieties of pyro-citrate may be included in the collective formula—

$$\begin{array}{ll} \gamma) & 2C_6; \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \\ \alpha) & 2(C_2:C_2:C_2);\overline{H_2O_2:2H;2C_2O-2H;2C_2O_3,} \\ \beta) & 2(C_4:C_2); \end{array}$$

which is thus shown to be identical with the *c* meta-citraconite of the second scheme.

It is, moreover, of importance to point out that the three pyro-citric isomerides belong each and all to the class of meta water-salts, while their corresponding ortho modifications remain yet to be discovered. Now I have good reason for believing that the *α* variety answers to the itaconate, the *β* variety to the citraconate, and the *γ* variety to the mesaconate, and I ground my belief, amongst others, upon the fact that the itaconate is directly convertible by heat into the citraconate, and the latter into the mesaconate; with this difference, however, that the calorific agency requires to be combined with the catalytic agency of substances like nitric or hydriodic acid, whereas every attempt of directly converting the itaconate into the mesaconate, and *vice versa*, has invariably proved a failure. But since, as my formula implies, these isomeric relations are due to certain typical differences in the mode of condensation, which the constituents of the complex carbon adjunct are liable to experience, it stands to reason that the *α* arrangement (where the three elementary carbon molecules are placed in juxtaposition) requires to pass first of all into the *β* arrangement (where two of these carbon molecules are condensed into one, while the third remains in *statu quo*) before it can merge into the *γ* arrangement (where all the three carbon molecules are condensed into one).

(2). Let us, in the second place, contemplate the effects of oxidising and reducing agents upon the three pyrocitric isomerides. According to Carius, when the three pyrocitric varieties are treated with hypochlorite of water, $2H_2O_2.2Cl_2O_2$, the resulting products are the so-called ita- and citra-chloromalates, to which I shall assign the collective formula—

$$\begin{array}{ll} & \qquad\qquad\qquad\qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \\ \alpha) & \overline{2(C_2:C_2);H_2Cl_2-2C_2;H_2O_2:2H;2C_2O_3-2H;2C_2O_3,} \\ \beta) & 2C_4; \end{array}$$

which is based upon the following train of reasoning:—I suppose that the formous acid principal of one molecule of pyro-citrate becomes oxidised at the expense of the acid constituent of the hypochlorite, while the liberated chlorine re-unites with the two molecules of basic wate The resulting two molecules of chloro-peroxide of hydrogen, $2H_2Cl_2O_2$, are then made to surrender their oxygen to the formous acid principal of a second molecule of pyro-citrate, while the two molecules of hydrochloric acid which remain, by instantly transposing with the colligated alcohols of the the two newly-formed oxypyro-citrate of water molecules, give rise to the corresponding chlorides; at the same time, the two liberated water molecules, instead of being eliminated, appropriate a molecule of formen from the complex carbon adjunct, &c., with final production of the afore-mentioned ita- and citra-chloromalates. It is worthy of note that, when the solutions of their salts are boiled, they give rise to the so-called ita- and citra-tartrates, to which I attribute the formula—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \\ \alpha) & \overline{2(C_2:C_2);H_2O_2-2C_2;H_2O_2:2H;2C_2O_3-2H;2C_2O_3,} \\ \beta) & 2C_4; \end{array}$$

because the metamorphosis is evidently accomplished by the previously formed hydrate of the base transposing with the colligated chloride. It will be seen that this formula is identical with the *b* meta-citraconéite of the second scheme.

Again, if we treat the water-salts of these acids with zinc, the metal becomes oxidised at the expense of the formic acid principal and the newly-formed hydrate of zinc, by transposing with the colligated chloride, gives rise to the ita- and citra-malates of our handbooks, whose collective formulæ—

$$\begin{array}{l} \qquad\qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \qquad H_2O_2. \\ \overline{2(C_2:C_2);H_2O_2-2C_2;H_2O_2:2H;2C_2O-2H;2C_2O_3,} \\ 2C_4; \end{array}$$

agrees entirely with the *b* meta-citraconite of the second scheme.

Theoretically, the reducing action of sodium amalgam or hydriodic acid on the three pyro-citric isomerides ought to yield three varieties of meta-pyrotartrate; but practically the reaction appears to culminate in the production of the ordinary pyrotartrate only. This unexpected deviation from what may be termed the normal course of the reaction is readily explained on the hypothesis that the three looked for varieties are actually formed in the first stage of the process, but that in the existing conditions the *α* and *γ* varieties are first changed into the *β* variety, which, by the method of orthogenesis, is ultimately converted into the ordinary pyrotartrate.

I may observe here that the *α* variety of this compound seems to have recently been obtained by Dittmar, viz., by subjecting Ritthausen's glutanate to the reducing action of hydriodic acid. The desoxyglutanate, as it is called by its discoverer, differs considerably from the *β* pyrotartrate, not only in the smaller size of the crystals, but likewise in the melting-point, which is several degrees lower, while it resembles the *β* variety in its readiness to split up into 2 molecules of water and the anhydride. I have, therefore, no hesitation in attributing to the aforesaid glutanate the collective formula—

$$\begin{array}{ll} & \qquad\qquad H_2O_2. \qquad\qquad H_2O_2. \quad H_2O_2. \quad H_2O_2. \\ \alpha) & \overline{2(H_2C_2:C_2);H_2O_2-2C_2};H_2O_2:2C_2O-2C_2O_3, \\ \beta) & 2H \end{array}$$

where the α variety corresponds to Ritthausen's glutanate; while the β variety, from which the ordinary pyro-tartrate ought to be obtainable with the aid of reducing agents, remains yet to be discovered. Another point of interest which the glutanate possesses consists in its isomeric relations to the ita- and citra-malates, on the one hand, and to the oxy-pyrotartrate on the other hand, for a comparison of their formulæ shows that these three isomerides are genetically connected with each other as iso, meta, and ortho modifications.

In drawing these lines to a close, I may be permitted to express a hope that this paper, in conjunction with those that precede, will not be thought unworthy of a careful perusal and searching examination.

PROFESSOR BISCHOF ON FRANKLAND AND ARMSTRONG'S METHOD OF WATER ANALYSIS.

Professor Gustav Bischof, of the Young Chair of Technical Chemistry, Glasgow, read a paper on "Frankland and Armstrong's Method of Water Analysis," at a recent meeting of the Chemical Section of the Philosophical Society of Glasgow. Considering the conflicting evidence at present existing in regard to that method, it appeared to Professor Bischof desirable to test it in several ways in which, so far as he was aware, it had not been tested. He divided the method into three stages:—1. The measurement of the gases. 2. The combustion. 3. The evaporation of the water. The accuracy of each stage was tested separately, in order to ascertain to which stage any inaccuracies might be due.

1. Pure carbon dioxide and nitrogen gases were mixed in about the same ratio as that in which they occur in water. The mixture was determined repeatedly by measuring their total volume, and the volume of the two gases separately, all the reagents being introduced into the laboratory vessel required for the analysis. Such quantities of carbon and nitrogen as occur in pure water could be readily measured to within 0·69 per cent of the actual quantity present. There was only one unaccountable exception to this rule amongst a large number of measurements. When measuring 0·76 c.c. of the mixture, the author found 93·58 per cent of carbon and 6·42 per cent of nitrogen, instead of 89·02 per cent of carbon and 10·98 per cent of nitrogen. His first supposition, that this might be due to an absorption of the nitrogen by an unusually large proportion of the reagents employed, had to be abandoned; for, after leaving 0·08 c.c. of nitrogen in contact with a large excess of the reagents over-night, its volume remained perfectly unaltered. He was therefore strongly inclined to attribute this one incorrect result to an error in reading off the divisions of the measuring-tubes. He found, however, that it was of no consequence, in measuring very small quantities of gas, whether the solution of the reagents were allowed to pass more or less into the horizontal thermometer-tube connecting the laboratory vessel with the measuring-tubes, and that it made a considerable difference if the gas were passed in one instance on to the right, and in another to the left, side of the first stopcock, especially if the latter bulged out instead of the bore of the thermometer-tube remaining equal throughout. As it was difficult to stop the inflow always at exactly the same place, a few graduations on the horizontal tube might allow for a connection in the case of very small volumes of gases. In connection with this part of his subject, the author directed the attention of the Section to an ingeniously-constructed pipette that he was in the habit of using; and he proceeded to say that, in measuring gases resulting from combustions, carbon monoxide was, in his experience, more frequently present than should be expected from Sutton's description, and he therefore always tested for it. The gas resulting from the combustion of the residue, after the evaporation of an impure water, was next divided into several portions, which were, without exception, determined with the greatest accuracy, as was evident from the relative proportions of carbon and nitrogen obtained.

2. The author stated that he made the copper spirals used in the combustion-tube by winding evenly fine copper wire round a central wire. He preferred having this, as also the copper oxide, tight in the combustion-tube. As the latter might choke, he always allowed a drop of water to fall on the sealed end of the combustion-tube after the combustion had been finished, and the test-tube containing the gas removed. The falling of the mercury in the delivery-tube of the air-pump at once indicated whether or not the combustion-tube was choked. However fine and tight the copper oxide might be, choking was found to take place very rarely. The residue from the evaporation was divided into several portions, which were burnt and measured separately, and the results examined.

3. Like quantities of Loch Katrine water were evaporated under the same and under different conditions as to temperature, but always under the glass shades; and the author thought he might conclude from the results thus obtained that the temperature and the time allowed for evaporating the water were of some consequence, inasmuch as a somewhat larger proportion of organic nitrogen was obtained if the evaporation were finished in a comparatively short time—say, a litre in about twenty hours—than if, at a lower temperature, five or six days were allowed. He could not explain this in any other way than by supposing a fermentation to set in, thereby altering the nitrogenous organic matter; that was not impossible, as the sulphurous acid added acted as an antiseptic. However, as Dr. Frankland did not add that acid to the contents of the evaporating-dish, but only, if required, to the flask in which it was boiled and kept, such a fermentation might set in if the water, after the sulphurous acid had been driven off, were kept for a long time at a temperature of, say, about 70° C., without adding any new portion from the flask.

Three questions still remained for further consideration, namely—

1. The action of any free acid that might be formed in the organic matter during the evaporation.
2. The estimation of the nitrates and nitrites.
3. Whether the results were reliable in analysing very pure waters.

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL,

IN CONNECTION WITH THE

SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

(Continued from p. 69).

Some experiments were performed at Lacy Brothers, Callis Mill, near Hebden Bridge, upon two of Galloway's New Patent Boilers, 28 feet long, 7½ feet diameter, and working at 90 lbs. pressure, one of them fired by hand, the other by the self-feeding furnace. The results of tests show a gain of 15 per cent in favour of the self-feeder.

Results of Tests, January 22, 23, 1874, at Messrs. Lacy's.

Firing		Time, in hours.	Coals Used.		Water Evaporated.	Pounds of Water Evaporated per lb. of Coal.
			cwts.	lbs.	gallons.	
Hand-fired	..	10·5	75	0	7150	8·42
Self-feeding	..	10·5	69	26	7700	9·93

William Young, Brothers, Queen Street, London, show a Smoke Preventer with spiral bars, for every description of furnaces, grates, and stoves. By means of this apparatus the fuel is introduced at the bottom of the fire, under the burning coals, and thus the production of smoke is prevented. The smoke preventer is composed of spiral bars mounted on an axis, which is moved by hand or machinery each time coals are required; in an ordinary fire-grate, there is a small trough at the bottom, in which works an axis carrying two vanes of fire-bars. The coal is put into the trough, and the poker is used, not to poke the fire, but to turn the fire-bars round, thus turning the fresh coal under the ignited coals.

Piercy, of Birmingham, exhibit an apparatus called a Mechanical Stoker, patented by Dillwyn Smith. It is a very ingenious arrangement for feeding the furnace mechanically. In front of the fireplace is a cylinder about 4 feet long and 8 in diameter; up the top of this is a hopper which will hold about 5 cwts. of coal. In the cylinder revolves two Archimedean screws, one right and one left, which carries the coal into chambers, one underneath each screw. In these chambers revolve two fans, which throws the coal the whole length of the furnace, the quantity of coal being regulated by the requirements of the boiler.

Sudlow, of Oldham, exhibits a Rotary Engine, the advantages of which are as follows:—It obviates the dead points or centres of the crank, and consequent ever-varying leverage, the steam acting at an uniform distance from the centre throughout its entire travel. It also gives an increased longitudinal capacity, wherein to expand high pressure steam without incurring pressure, as in the case of compound engines; also, where necessary, the fly-wheel can be entirely dispensed with.

Reese anb Gledhill show Wright's Patent Movable Fire-Bar. The rapid and complete manner in which they operate upon the combustible matters used decreases the formation of clinker or slag, by removing the refuse while in a state of dust before it has time to cake into a clinker. By their peculiar advancing and retiring action, the slag that is formed at the extreme back of the furnace is brought, with every successive action of the bars, and deposited on the dead-plate, or mouth of the furnace. This is an advantage of the greatest importance, as the removal of slag from the extreme back of furnaces has always been attended with great dificulty and the periodical destruction of the fire. A thorough and complete combustion is effected by the breaking up and removal of the slag, and consequent free admission of air between the bars, and a large saving is effected in the usual consumption of coal.

Mr. Gall, of Halifax, shows a Patent Self-Acting Smoke Preventer, with the recommendation that it will reduce the smoke emitted from the chimney by seven-eighths; and should this result not be attained the purchaser may, within one month, return the Preventer to the patentee, and no charge whatever will be made.

Dingley and Son, of Leicester, exhibit Lake's Coal Economiser, which, according to the statement of the patentee, will save from 10 to 15 per cent on stationary boilers, and from 20 to 25 per cent on multitubular boilers. This arrangement consists of a conical, fluted, or corrugated valve, applied to the rear end of the tube and capable of being adjusted as required; the openings round the valve, being the outlet for the draught, and which are proportioned to the area over the bridge, cause the fire to be kept in close contact with the plates around and throughout the entire length of the tube, ensuring more perfect combustion and equal distribution of the heat within the boiler. It is applied without in any way altering the boiler or interfering with present draught.

Howard's, of Bedford, show their celebrated Safety Boiler; and among the leading features of this boiler are, safety (every boiler is tested to three times its working pressure, and the bursting pressure of the tubes is at least 1500 lbs. per square inch), great simplicity of parts, facility of repairs, and durability. In the Howard Safety Boiler there are neither seams nor rivets, and no joint is exposed to the direct action of the fire; the tubes are counterparts of each other, and every part is made on the interchangeable principle; and it is more readily accessible, both internally and externally, for thorough inspection and cleaning than almost any other form of boiler—high pressure steam, with economy of fuel. With this boiler a pressure of 120 to 140 lbs. per square inch is more secure than ordinary boilers working at 50 lbs., while experience has shown that on the great question of economy of fuel the hopes entertained that the higher pressure of steam would, under proper conditions, lead to an important saving of coal have been realised.

A similar boiler is shown, and called the Safe and Sure Boiler, by the Patent Steam Boiler Company, of Birmingham. They claim for their boilers absolute safety from explosion; this advantage is obtained by the sub-division of steam and water in small tubes tested to a pressure of 500 lbs. to the square inch. If a tube should burst, the only result would be a rush of steam and water into the furnace, a sudden lowering of the steam pressure, and the extinction of the fire. A boiler is often thrown aside as useless nine-tenths of which is practically good, but from the remaining tenth having failed the whole has to be rejected; with this boiler that one-tenth could have been replaced by a new one in perhaps less than two hours, when the whole would have been as good as ever. The nature and disposition of the heating surface in this boiler are such as cannot fail to fully utilise the heat applied, while the internal arrangements are such as entirely prevent the escaping gases becoming much above the temperature of the steam, and ensures, with an ordinary amount of attention, perfect consumption of the smoke.

Stanley, of Sheffield, shows his Patent Furnace for Smelting Ore. The advantages of these furnaces are, in the first place, they affect a saving of from 25 to 30 per cent in fuel. The use and expense of grate-bars are dispensed with, as these furnaces have closed fire-places formed in brickwork; they make from 80 to 90 per cent less ash than open fire-grate furnaces, the workmen have much less labour in working these furnaces, and the heat is quicker and more under the control of the furnace men.

Bailey and Co., of the Albion Works, Salford, make a very fine show of Pyrometers, Hallam's Ejectors, Oil Testers, and other useful inventions. Bailey's Patent Pyrometer is used for indicating heat, saving coal, and promoting uniformity of production in malt-kilns, ovens, and in other places where a certain degree of heat is requisite. The pyrometer for malt-kilns is 4 feet long, and has an enamel dial 4 inches in diameter; the dial is indicated to 300°—black figures on a white ground. One of these pyrometers has been tried at the Valley Mill, near Holyhead, and the proprietor has tested it and found it very sensitive at any change of temperature, enabling the man to keep his kiln at the proper heat, which is very important in malt-kilns. These pyrometers are also used by the Government departments for baking bread; it is also used for indicating the waste heat in flues of works and locomotives, for indicating the temperature of blast-furnaces, gas retorts, and other useful purposes where high temperatures are used.

Bailey's Oil Tester is a very ingenious instrument for finding out the value of oils as lubricants; and if good oil is used for lubricating, it reduces friction in the machinery, and thus saves coal and wear and tear. The tester may be briefly described as a piece of 3-inch shaft and two brass steps, upon which frictional pressure is obtained by weighted levers; a thermometer is fixed upon the machine, to denote the temperature. One drop of oil is put on to a drum of 3 inches diameter, friction is applied, and the "life time" of the oil (which is the technical term) is indicated by means of a speed indicator, which indicates the number of revolutions required to raise the temperature a given number of degrees. The exact money value of oil may be arrived at as follows:—Suppose a certain quantity of No. 1 oil on the machine shows 200° by being driven 10,000 revolutions, No. 2 oil shows 200° and 7500 revolutions, or 25 per cent less value. In addition to this practical way of obtaining a result, the machine may be driven to a higher temperature, to see which oil produces the worst residue. In testing various oils, a certain weight or measure must be taken; the thermometer should always indicate the same temperature at starting. It is found that 200° F. is the best to try all oils to, if their lubricating power is to be consumed, and the machine should be always driven until that temperature is indicated, and then immediately stopped; the bearings of the spindle should be well oiled, to prevent friction in the wrong place, when a temperature of 200° has been obtained (the speed index showing zero at the start), it should then be seen the number of revolutions taken to produce the temperature. After testing the oil, it is directed that the machine be stopped, and the oil is to remain on the machine, and in twelve hours after it is to be tested again to see how soon 200° can be obtained; the second experiment will indicate which oil is the inferior on machinery when stopped. The following is a short table of results on trying these various kinds of oil:—

Quality of Oil.		Temperature produced.	Total indicated Speed of Three Tests.	Market Price per gallon. s. d.	Real value of the Oils, taking No. 1 as a standard. s. d.
No. 1	..	200	120,000	6 0	6 0
No. 2	..	200	180,000	4 0	9 0
No. 3	..	200	60,000	2 6	3 0

It will be seen that No. 2 oil will allow 50 per cent more revolutions to be performed than No. 1, and must therefore be worth 50 per cent more money.

Messrs. Johnson and Hobbs, of Manchester, exhibit a model of a Patent Apparatus for the Condensation of Smoke, Gases, &c. This apparatus is exceedingly simple and inexpensive in its construction; it is on the paddle-wheel principle, with an addition of projections on the blades to produce a finely-divided spray of water, which falls through a series of network composed of laths, brushwood, shingle, or other material, and is so arranged as may seem best for arresting the substances to be operated upon. The same liquid may be used over and over again, until charged to any extent that may be desired. The inventors declare that this machine will be found more effective than the expensive condensing towers now used for the purpose, as it produces a powerful draught, which can be regulated at will, and the solution can be made in the machine as concentrated as may be required. The machine has been tried in condensing ammonia, and has been found to succeed thoroughly; the working parts of the apparatus can be arranged to resist the action of hydrochloric and other powerful gases affecting metal work.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 5, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed, after which Messrs. F. M. Rimington, J. Reddross, and F. H. Davies were formally admitted Fellows of the Society.

The names read for the first time were those of Messrs. George Chaloner, Thomas Charles, M.D., Henry Leicester Greville, A. S. Napier, B.Sc., Saranoske M. Nishigaiva, John Linford, James T. Armstrong, Harry Edgecumbe Thomas, and F. V. L. Cruse.

For the third time—Messrs. Howard Barrett, Thomas Pemberton Wiltshire, George Whewell, and John Young, who were ballotted for and duly elected.

The first communication was a "*Preliminary Notice on the Action of Benzyl Chloride on the Camphor of the Lauraceæ (Laurus camphora),*" by Donato Tommasi. When camphor is heated with benzyl chloride and zinc, a violent action takes place, accompanied by the evolution of much hydrochloric acid. The distillate, after the removal of the hydrochloric acid and water, is re-distilled, by which means it is separated into two portions—a more volatile one, which passes over, and a viscous residue, containing a crystalline substance whose nature is at present undetermined. Six liquids, boiling at various temperatures from 108° to 204°, were obtained from the volatile portion by careful fractionation, the first of which, boiling at 108° to 112° C., appears to be toluol. It is probably produced by the action of nascent hydrogen on the benzylic chloride, thus—$C_7H_7Cl+H_2=C_7H_8+ClH$.

The President having thanked the author in the name of the Society, Dr. C. R. A. Wright read a communication entitled "*Isomeric Terpenes and their Derivatives* (Part III., *On the Essential Oils of Wormwood and Citronelle*)." This paper consists chiefly of a detailed account of the author's experiments on these compounds, which had been previously communicated to the Society in a preliminary notice. The oil of wormwood, besides absinthol, yields a blue liquid of high boiling-point, Gladstone's cerulene, and also a small quantity of a terpene boiling at about 150°. The purified absinthol, $C_{10}H_{16}O$, boils at 200° to 201° (corrected). In the oil of citronelle he found a body, $C_{10}H_{18}O$, easily alterable by heat, boiling at about 210° to 225°, whilst Gladstone stated the main constituent to be a body boiling pretty constantly at 199° to 205° C., and having a formula $C_{10}H_{16}O$, so that it is probable the composition of the oil of citronelle varies with the season, age of the plant, &c. Treated with zinc chloride, absinthol yields cymene, whilst citronellol appears to give a mixture of hydrocarbons, the principal of which contains much more hydrogen than cymene. Phosphorus pentasulphide and absinthol, as previously noticed, yield cymene and thio-cymene, $C_{10}H_{14}S$, the latter forming with silver nitrate (not in excess) a yellow salt, sparingly soluble in alcohol, $C_{10}H_{13}AgS$. Citronellol, with the same reagent, yields a mixture of hydrocarbons, amongst which is one having the composition $C_{10}H_{16}$. The action of phosphorus pentachloride on citronellol causes an evolution of hydrochloric acid, and the formation of a chlorinated organic substance, which breaks up on heating, leaving a mixture of terpenes and resinous polymerides thereof. Citronellol, as already noticed, unites with bromine, and the product, $C_{10}H_{18}Br_2O$, splits up when heated, with formation of cymene, thus—

$$C_{10}H_{18}Br_2O=H_2O+2HBr+C_{10}H_{14}.$$

The cymenes obtained in these various reactions, when oxidised with chromic liquor, yield nothing but terephthalic acid, acetic acid, and carbonic dioxide, showing that they are identical.

Dr. Odling said he had listened to the paper with great interest. Although we imagined that we were able to explain so many cases of isomerism, it appeared there were instances, as in the compounds of hydrogen and cymene, which were but imperfectly understood.

The author replied that it was difficult to explain the existence of four isomeric dihydrides of cymene on the ordinary supposition that the latter was a benzene derivative having the side chains opposite to one another—that is, in the 1:4 position. From thermo-chemical considerations, however, if the terpene could be regenerated by the combination of hydrogen and cymene, we should doubtless find that the different isomerides during their formation would develope different amounts of heat. The four isomerides which had been examined—namely, terebene, the hydrocarbon from oil of lemons, the terpene from oil of nutmegs, and that from oil of orange-peel—differed both in their boiling-points and in their oxidation-products. With bromine and with sulphuric acid, they all gave rise to like products, but different amounts of heat were developed during the reaction.

The next paper was a "*Preliminary Notice on the Perbromates,*" by M. M. Pattison Muir, F.R.S.E. The author forms the perbromic acid by the action of bromine on an aqueous solution of perchloric acid. On neutralising with potassium hydrate, potassium perbromate is obtained in a crystalline state, being difficultly soluble in cold water. It is isomorphous with the perchlorate and periodate. A crystalline barium perbromate is obtained on mixing aqueous solutions of barium chloride and the potassium salt, and adding alcohol; copper perbromate forms a pale green powder.

The **PRESIDENT** having thanked the author in the name of the Society, the **SECRETARY** proceeded to read a paper "*On the Coals from Cape Breton, their Cokes and Ashes, with some Comparative Analyses*," by **HENRY HOW**, D.C.L. This paper contains the results of the examination of the Main Seam Coal at Sydney Mine, Nova Scotia, and of the Lingan coal-mine, giving the amount of cokes produced by fast and slow coking. The author states that there are not many published quantitative analyses of coal ashes, although general enumerations of some of their constituents are by no means uncommon, and, after criticising the various published analyses, gives those made by himself of the ash of the Sydney main coal and of the Lingan coal, comparing them with those of "Boghead."

Dr. **ODLING** said the results were not new, especially the varying amount of coke yielded by the coal in experiments on small quantities. The proportion of any constituent of the ash—as, for instance, the lime in a true coal yielding only 1 or 2 per cent of ash—could scarcely be compared with that of a substance, like the torbane mineral, containing as much as 30 per cent of inorganic matter.

The meeting was then adjourned until Thursday, February 19, when there will be a lecture "On the Detection and Estimation of Adulteration in Food and Drinks," by Mr. J. Bell, F.C.S. Lectures are also announced for March 19, "On Dissociation," by Mr. J. Dewar, F.R.S.E., and for May 21 on "The Sewage Question from a Chemical Point of View," by Dr. W. H. Corfield, F.C.S.

CORRESPONDENCE.

FILTERING APPARATUS.

To the Editor of the Chemical News.

SIR,—Permit me a word of explanation on the references contained in the letter of Mr. J. F. Kerr (vol. xxix., p. 71), to the filtering apparatus proposed by me in vol. xxvii., p. 261. I merely wish to correct a mistake which I did not write to correct at the time, thinking that the error was too gross to mislead any reader.

The weight of the ash of the carded cotton-wool used for the filter was given by me as less than $\frac{1}{100}$th grain; it was misprinted as less than 100 grains. I supposed it would be evident at once that no operator could be satisfied with a residuum which is greater than the total quantity usually operated upon of the substance to be analysed.

I would not say a word in depreciation of the beautiful apparatus of Dr. Carmichael when used for very exact analysis; but for technical purposes the manipulation is too tedious, and few flat-bottomed thin-glass beakers can bear a pressure anything like approaching to a perfect vacuum. The flask of 200 or 300 c.c. does bear a complete vacuum without danger of fracture; and the rarefaction arising from the condensation of steam gives the advantage over Mr. Kerr's method derivable from a pressure of, say, equal to 25 feet of water, instead of the 30 inches which his syphon offers.

The inversion of the flask is no source of inconvenience, and, in fact, the weight of the flask reared against an angle makes it much more easily adjustable to the lowest point of the substance to be filtered than if it stood on its own foundation and had to be lowered, or the other vessel raised, to meet one another. The flask has this advantage over Dr. Carmichael's method, that the filtration can be effected in the vessel in which the precipitate which is left can be immediately dried and ignited.—I am, &c.,

ISAAC B. COOKE.

19 and 43, Brown's Buildings, Liverpool,
Feb. 7, 1874.

EVOLUTION AS APPLIED TO THE CHEMICAL ELEMENTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS for January 23rd (p. 43), Mr. W. H. Wood took upon himself the criticism of my article in *Nature*, Nov. 6th last, in default, as he says, of more experienced chemists. But, as this question is as much one of physics as of chemistry, perhaps it would have been better if he had left the matter in the hands of MM. Berthelot and Dumas, who have been lately discussing it, instead of committing himself by supposing that the melting-point of arsenic or any other body is independent of the pressure.

The fact is that the melting-points of As, Sb, and Bi, cannot well be compared together, as it is only under pressure that As will melt. But if we look at the temperature at which these bodies pass into vapour, As is found to volatilise readily at 180° (Miller); whilst, according to Watts's Dictionary, Sb melts at 430°, and volatilises at a red heat; Bi requires a still higher temperature to volatilise it, but melting as low as 260°. So these elements are not quite so anomalous as Mr. Wood tries to make out. But as to the chemistry of the question, I must own that Mr. Wood, where he finds fault with me, is in the right. I have to thank him for pointing out that, by an oversight, atomic heat was written for specific heat. If Mr. Wood wishes to hear the discussions that have lately been raised on this point, in *Comptes Rendus*, vol. 77, No. 23, he will find there a letter from Mr. N. Lockyer, read before the Academy, where, on the ground of the existence of hydrogen in the hottest of the stars, and, on the other hand, the late appearance of the metalloids in the history of the universe, he advocates what he terms the plasticity of the metalloids. The conclusion that he here arrives at, first brought before the Royal Society, is supported by Dumas, but opposed by Berthelot on the ground chiefly of the specific heat of the elements. He shows that the specific heat of the elements follows different laws from that of compounds, particularly instancing the hydrocarbons.—I am, &c.,

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CHEMICAL NOTICES FROM FOREIGN SOURCES.

ote. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 22, 1873.

Action of Incandescent Substances in the Transmission of Electricity.—M. Doulot.—Carbon and platinum act oppositely. Thus, a cylinder of glowing charcoal being substituted for the ball of an electroscope, if one bring near a positively charged body, the leaves will quickly diverge till they are discharged by the metallic balls on either side; then diverge again, and be again discharged; and so on, as long as the electrified body is held near. If it be removed before the leaves reach the balls, they remain apart, with positive electricity; thus the carbon has allowed the negative electricity to flow off. The results are different where a negatively electrified body is used. The electroscope is affected only at a very small distance; the leaves separate less quickly, and they come together promptly, whenever the source of electricity is withdrawn. These phenomena are quite opposite to those observed by M. Erman with the uphlogistic lamp—that is, with an incandescent platinum wire,—which indicate that incandescent platinum allows positive electricity to flow away more readily than negative.

Muddy Eruption of Nisyros.—Letter from M. Gorceix.

Limit of Ice in the Arctic Ocean.—M. Ch. Grad.—As meteorological conditions change from year to year, the state and extension of ice vary also. But every year, and even during winter, spaces of open water and navigable passages appear throughout the whole mass. The practical inference is the importance of steam vessels, instead of sledges, in scientific expeditions to the pole.

Physical Constitution of the Sun.—(Reply to the criticisms of M. Faye).—M. Vicaire.—After answering M. Faye's objections to his method, the author takes up some of the general objections made to the results. The first is incompatibility of his (M. Vicaire's) theory with the nebular hypothesis of La Place. He indicates the principle by which he hopes to connect his views with those generally admitted as to the origin of the solar system. Originally, an extreme temperature kept the elements of the solar nebula in the state of dissociated gases. As cooling went on combinations may have commenced to form; at the same time pressure increased to the centre, since the approximation of parts increased the intensity of gravity. At a given moment a condensation may have occurred, either from a stable combination having been produced or from pressure. The nucleus thus formed at the temperature of the nebula, having a much greater radiating power, must have cooled quickly, and so strongly accelerated the condensation. That metals, or bodies like hydrocarbons, should be the first condensed, while oxygen remained in the gaseous envelope, is only natural. Later, a time came when the inverse phenomenon commenced,—that is, the combustion of the central nucleus; this was the stellar period. Before this series of phenomena the mass doubtless formed an irregular or unstable nebula, the incoherent elements of which, precipitated against each other, developed intense heat. It was then that it passed to the state of a round or elliptical nebula, with condensation increasing to the centre; then to the state of a nebulous star; and, lastly, a star. This theory simply conforms to the laws of Physics, and it agrees with the facts revealed to us by the starry heavens. The contraction, *en bloc*, supposed by M. Faye, excludes all these analogies. It is, besides, impossible that this contraction, as he thinks, was accompanied with heating. The author's theory, he holds further, agrees with Dr. Blandet's geological considerations; and it appears that the stellar period of the sun must have commenced towards the end of the geological history of our globe. Again, the central nucleus must have taken a more rapid rotation than that of the envelope, the matters collected retaining, in part at least, their initial velocity. If this state of things still subsists, spite of friction, it is because the eruptive phenomena, spots, and protuberances, by the force of impulsion they produce, and which is manifested to us by an increase of velocity towards the equator, compensate that retardative action. Some minor points (the zodiacal light, the tail of comets, &c.) are also noticed, and the question as to the duration of the sun in his stellar phase M. Vicaire reserves for a separate paper.

Process for Measuring the Relative Intensity of the Constituent Elements of Different Luminous Sources.—M. Trannin.—This process is independent of the direct judgment of the eye. The apparatus consists, first, of two rectangular prisms with total reflection, superposed and turned in inverse direction, so as to send in the same direction, and one above the other, the luminous bundles from two sources placed on either side, in a line which is perpendicular to the common axis of the double bundle reflected by the hypothenuse faces. These prisms are placed before a narrow slit, which is thus divided into two parts, in general differently illuminated. Behind the slit is a collimator making the rays parallel. They then traverse, successively, a polariser with its principal section vertical; a quartz plate, about 1 centimetre thick, parallel to the axis, and the principal section of which makes an angle of 45° with that of the polariser; and a Rochon or Wollaston prism, having its principal section parallel to that of the polariser, and thus vertical. The dispersive prism and the telescope of a spectroscope finally receive the rays. Now each of the elementary bundles issuing from the quartz plate is polarised elliptically; and this kind of light, after passing through any bi-refringent analyser, gives two bundles with unequal intensities polarised at a right angle, but the sum of which is constant and equal to the sum of the squares of the velocities parallel to the two axes of the ellipse. The bundle, after traversing the Rochon prism, then gives in the spectroscope a spectrum of several horizontal bands; that in the middle is due to the superposition of the ordinary bundle from one part of the slit, with the extraordinary from the other; and it will therefore be, for the eye, as if completely depolarised if these two portions are equally illuminated. Above and below this middle part will be seen two cannellated spectra, the dark fringes of the one alternating with those of the other, and between the two the luminous band referred to. If this equality do not exist for a determinate part of the spectrum, the fringes will appear anew in this part, and they may be made to disappear by diminishing the intensity of the predominant bundle, by withdrawing the luminous source, or interposing a Nicol between eye and ocular.

Researches on the Oxygen Compounds of Nitrogen; their Stability and their Reciprocal Transformations.—M. Berthelot.—Hyponitric acid is rightly regarded as the most stable of the oxides of nitrogen. If heated to 500° in a sealed tube for an hour it gives not the least sign of decomposition. It does not react either upon oxygen in the cold or upon free nitrogen at a dark red heat and in the same conditions. A series of electric sparks reduces it in a sealed tube, filled at the temperature of 30° and at ordinary atmospheric pressure, reducing it to its elements $NO_4 = N + O_4$. The decomposition stops at a certain term, as in every case where the spark developes an inverse action. After 18 hours electric action the mixture consisted of—N, 28 vols.; O, 56; and NO_4, 14. On acting with the spark upon atmospheric air 7·5 per cent was converted into hyponitric acid in an hour; 18 hours of electrisation did not sensibly modify this proportion. *Nitrous Acid* (NO_3).—Few reactions have been more studied than that of nitric oxide with oxygen, in presence of water. It was found that the proportions of the gases absorbed might vary from 3 : 4 to 3 : 12. Nevertheless the effective reaction passes always through a definite first term, nitrous acid. Gay-Lussac observed that oxygen and nitrogen, mixed in the ratio of 1 : 4 in presence of a concentrated solution of potassa, yielded merely a nitrite. The author finds that it is the same whatever may be the relative proportions of the gases, and the order of the mixture, in presence of concentrated solutions of alkalies, and even of baryta water, provided that the nitrous vapour which appears for a moment in the mixture is immediately removed by means of agitation in tubes sufficiently large. Analysis shows that the proportion of nitrous acid formed answers to 96 or 98 per cent of the nitric oxide employed. If the reaction goes on without the absorption of the nitrous acid as it is produced, hyponitric acid soon appears, and analysis shows then, if oxygen is deficient, a mixture of the three gases, NO_2, NO_3, NO_4, whatever may be the relative excess of the nitric oxide. That is to say, that nitrous acid only subsists for some time in the gaseous form except in presence of its products of decomposition. This complex and variable mixture constitutes the so-called nitrous vapour whenever oxygen is not in excess. The same remark applies to the liquid acid; the purest nitrous acid obtained contains about one-eighth of hyponitric acid. If oxygen is present in excess hyponitric acid alone is formed, or at least remains existent. Nitrous acid being the initial product of the reaction, we are forced to admit that it unites afterwards with a second equivalent of oxygen in a dry gaseous mixture, as well as in presence of water. The second reaction offers the remarkable character of a true gaseous combination effected with expansion; 3 vols. of the constituent gases yielding 4 vols. Nitrous oxide, if exposed to a heat of 520° for half an hour in a sealed glass tube, is decomposed into nitrogen and oxygen to the extent of 1·5 per cent, without formation of any higher oxide. The sudden compression of nitrous oxide, under circumstances capable of effecting the detonation of a mixture of hydrogen and oxygen, determines mere traces of decomposition. Nitrous oxide, mixed with oxygen and heated to low redness in a sealed tube, yields neither binoxide of nitrogen (nitric oxide) nor nitrous vapour. Nitrous oxide further exerts no oxidising action in the cold on any known body, and is neither absorbed nor decomposed by potassa (aqueous or alcoholic) at any temperature which can be reached in a glass tube, even with the aid of time. By the electric spark it is rapidly decomposed, nitrous vapour appearing at once. In one minute, and with weak sparks (produced by a Ruhmkorff's apparatus acted on by two Bunsen elements), a third of the gas was decomposed. The decomposed portion was divided in nearly equal proportions between the two following reactions:—

$$NO = N + O.$$
$$4NO = NO_4 + 3N.$$

The first action may be regarded as due to the heat of the spark, whilst in the second heat and electricity concur. In three minutes, with stronger sparks (six Bunsen elements), three-fourths of the gas were decomposed in the same manner; the second reaction being rather in the upper hand. Nitric oxide does not appear in the electro-decomposition of nitrous oxide. The proportion of hyponitric acid formed represents about one-seventh of the final volume. The binoxide of nitrogen (nitric oxide) enclosed in a sealed tube, and heated to 520°, experiences decomposition. In half an hour a quarter of the original volume is resolved into its elements, according to the two following decompositions:—

$$NO_2 = N + O_2;\ \text{then}\ O_2 + NO_2 = NO_4,\ \text{or}\ 2NO_2 = N + NO_4.$$
$$NO_2 = NO + O;\ \text{then}\ O + NO_2 = NO_3,\ \text{or}\ 2NO_2 = NO + NO_3.$$

The formation of nitrous oxide predominates. Another experiment prolonged for six hours had nearly identical results. This tends to show that the decomposition of a body by heat may stop at certain limits in presence of the bodies formed. By the action of the electric spark, one-sixth of the gas is destroyed in a minute. One-third of the product formed was nitrous oxide, the rest being nitrogen and hyponitric acids. In five minutes three-fourths of the nitric oxide were destroyed, with formation of nitrous oxide, and of nitrous and hyponitric acids. Nitric oxide is less stable in ordinary conditions than nitrous oxide. Why, then, do sulphur and phosphorus continue to burn more easily in the protoxide than in the binoxide of nitrogen—a circumstance which has caused the latter to be regarded as the more stable? The explanation may be that the binoxide does not contain in equal volumes more oxygen than the protoxide, and, on the other hand, this oxygen does not become totally available for combustion except at a very high temperature; the binoxide being at first transformed to a great extent into hyponitric acid, a body more stable than nitrous oxide. The author announces a further continuation of this subject.

Reimann's Farber Zeitung, No. 44, 1873.

This number contains an article on dyeing artificial hair for blonde pads and chignons. If dyed with fustic and alum, with the addition of annatto and pansy-lake, it appears by artificial light too "carrotty." The desired shade is best produced by logwood and an iron mordant, with the addition of cudbear, fustic, and tartar.

There are several receipts for dyeing wool and woollen piece goods, from which we select the following:—

Nicholson Blue on Cloth.—To 100 lbs. of material take 1 lb. colour of the shade required, dissolve in boiling water, filter, and make up a dye-bath with the addition of ¼lb. sulphate of zinc. In this the goods are worked for an hour, whilst the liquid is gradually raised to a boil. They are then rinsed in cold water, and raised in a bath of warm water at 70° R., containing 2 lbs. sulphuric acid and ½ lb. sulphate of zinc. The dye resists acids and soap.

Nicholson Blue with a Wood Bottom.—100 lbs. of woollen cloth are boiled for an hour with 1 lb. chromate of potash and 1 lb. sulphuric acid, and allowed to cool in the liquid, lifted, rinsed, and dried in a fresh bath with 30 lbs. of camwood. 2 lbs. of Nicholson blue are now dissolved in boiling water, filtered and made up into a dye-bath with the addition of 1½ lbs. of sulphate of zinc. In this bath the goods are boiled for two hours, lifted, rinsed, and raised in a bath containing 8 lbs. sulphuric acid, and 2 lbs. of sulphate of zinc.

The next following receipt for magenta on woollen yarn contains nothing remarkable.

Aniline Violet on Woollen Yarn.—1 lb. of sulphate of magnesia is added to the flot at a hand heat; the goods (10 lbs.) are moistened therein, and methyl violet is gradually added, while the temperature is quickly brought to a boil.

Dove Colour.—Dye as for violet, using only ¼ to ½ oz. of colour.

There are also receipts for a logwood blue on woollen yarn, a light drap on wool, a dark drap, and a madder red, topped with cochineal, on wool and woollen yarn. We insert the last mentioned. 100 lbs. of the goods are boiled for an hour with 3 lbs. alum, 6 lbs. tin crystals, 5 lbs. tartar, and ½ lb. flavin. They are then lifted and boiled for an hour in a fresh bath with 15 lbs. madder. Meantime 4 lbs. of ground cochineal, 1½ lbs. of tin crystals, and 1 lb. oxalic acid are boiled up, cooled, the wool entered, and boiled for an hour.

There are also receipts for a verdigris green and a magenta ponceau on cotton yarn.

In the preparation of anthracen from coal-tar, constant agitation is recommended during distillation.

Armand Müller prepares an oil mordant for Turkey-reds with an emulsion of olive oil and a solution of glue. Into this solution hyposulphite of soda is introduced, the frothing mass is allowed to stand two or three hours, and immediately used.

No. 45, 1873.

This number contains a continuation of the article on finishing silks, and receipts for a yellowish mode on wool, for a sulphate of copper black and a reddish grey on cotton-yarn, for a blue-green, a medium green, a yellow-green, a bright yellow, and a full yellow on woollen yarn.

No. 46, 1873.

This number contains a continuation of the article on finishing silks; a paper on washing and curling ostrich feathers; receipts for medium and dark Havanna, yellowish grey, and dark silver-grey on plush; aniline-blue on silk (the kind of aniline-blue not being stated); and for six shades of bluish modes on wool.

Cultivation of Madder.—The Agricultural Society of Vaucluse having made enquiries as to the future prospects of the madder grower with reference to the introduction of artificial alizarin, the Industrial Society of Mulhouse gave the following reply:—"Artificial alizarin can never be suppressed, but along with it so much madder will always be used that its cultivation far from diminishing must increase. *As artificial purpurin is not yet known*, the extracts of natural madder must be used for the production of a yellowish red in order to have at command all the madder colours." (The passage we have italicised cannot be allowed to pass without comment. The artificial purpurin of Messrs. Perkin and Sons cannot surely have escaped the notice of the Mulhouse Industrial Society.)

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 13, November 27, 1873.

Artificial Sugar.—The formation of artificial alizarin suggests to the *Avenir de la Guadeloupe* the possibility of artificial sugar. What is to be the raw material is not distinctly stated.

Treatment of Cane-Juice.—The process of Boivin and Loiseau has been successfully applied in Queensland.

Improvement in Photo-Lithography.—M. Paul.—The author produces a positive image on paper covered with a layer of albumen mixed with a concentrated solution of bichromate of potash. After a sufficient insolation under the negative, the paper is covered with lithographic ink, and then immersed in cold water to dissolve the unaltered albumen.

Test for the Colouring Matter of Wines.—M. de Cherville.—Pour into a glass a small quantity of the wine under examination, and dissolve in it a morsel of potassa. If there is no deposit, and if the wine takes a greenish tint it has not been artificially coloured. If a violet deposit has been formed, the wine has been coloured with elderberries or mulberries. If the deposit is red, beet-root or peach-wood has been used; and if violet-red, logwood. If the sediment is violet-blue privet berries have been employed, and if a bright violet, litmus.

Revue Scientifique de la France et de l'Etranger, No. 24, December 13, 1873.

Congress of Italian Savants; Session at Rome.—At a meeting of the Chemical Section, under the presidency of Prof. Cannizzaro, a discussion arose on the rarity of original chemical research in Italy, and on its causes. The Section was of opinion that to awaken activity in this department it is desirable that the profession of chemistry should offer to students a career analogous to that presented by engineering or by medicine. (A similar complaint and a similar suggestion might be made in England, with the additional complaint that engineers and medical men are continually encroaching upon the sphere of the professional chemist.)

Nos. 25 and 26.

These numbers contain nothing bearing upon chemistry.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in musical instruments named the pyrophone. John Garrett Tongue, of the firm of Tongue and Birbeck, patent agents and engineers, 34, Southampton Buildings, Chancery Lane, Middlesex. (A commication from George Eugène Fréderic Kastner, member of the Committee for Inventions, Paris). March 24, 1873.—No. 1091. The pyrophone is an improved musical instrument of the description known as the chemical harmonica. It is well known that when a pure hydrogen gas jet burns in a glass or china tube, or other vibrating material, a pleasant soft tone or sound is produced. The characteristic novelty of this improved instrument consists in the construction of the burners, and in the combined apparatus employed to act on these burners by means of the touch on the keys similar to an ordinary piano, in order to obtain the sound or note required, or to stop it instantly as required. The burners are constructed with double oscillating branches in such manner that the two jets are brought into one by the contact of the two arms or branches, whilst at the moment the sound or note is produced the two branches are separated and form two distinct jets, which produce the vibration and consequent sound in the glass, china, or other tube which surrounds the branches of each jet or burner. These improvements in the construction of the pyrophone consist—First, in dispensing with the inlet cock for the gas. Second, in the means employed for dispensing with the two cocks heretofore employed for regulating the passage of gas to the two branches of each tube. Third, in a more simple arrangement of mechanism for transmitting the movement of each key to its own two corresponding branches.

Improvements in the preparation of ozone, and in the application of the same to various useful purposes. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Pierre Isidore David and Jacques Fichet, Paris). April 2, 1873.—No. 1222. This invention relates to a simple method of preparing ozone by causing atmospheric air to pass through water containing sticks of phosphorus, and to the employment of such ozone for the destruction of organic matter, the bleaching of fibrous and other substances, also paper either before or after it has been printed upon, also for giving age to alcoholic liquors, modifying the quality of oils and fatty matters, and rendering more salubrious the wards of hospitals and sick rooms.

Improvements in galvanic batteries. Lionel Weber, 104, Rue Royale, Place de Congrès, Brussels. April 5, 1873.—No. 1270. The claims to this complete specification are—First. The exclusive use and application of carburet of iron, of whatsoever denomination, quality, and production, for generating electricity in galvanic cells and batteries generally. Second. The employment of a jar of particular shape, made of glass, of porcelain, or any other appropriate substance.

Improvements in the method of and in apparatus for ascertaining the temperature of hot-blast or of heated gases, partly applicable to pyrometers otherwise used. Henry Hobson, Workington, Cumberland. April 5, 1873.—No. 1271. The inventor brings together hot- and cold-blast in known proportions, and tests this mixture with a pyrometer or thermometer for temperature. When constructing a pyrometer for the above or for ordinary uses, he employs metal wire, riband, cord, or chain wound upon pulleys to make the instrument more compact, one end of the wire being connected with the index either directly or by means of multiplying pulleys and chains or wires. Levers may be substituted for the first-named pulleys.

Improvements in the treatment of substances and liquors containing ammonia and cyanogen, and in obtaining products therefrom. Arthur William Ellis, manufacturing chemist, Madeira Villas, Woodford, Essex. April 7, 1873.—No. 1274. Freeing cyanogen (evolved in the distillation of ammoniacal liquor) from aqueous vapours before passing it into a combining agent, and also the use of an additional vessel or additional vessels in order the more completely to attract and retain the cyanogen.

NOTES AND QUERIES.

Decolourising Syrup.—Could you kindly inform me if you are aware of Mr. Beanes having done anything towards perfecting his process of decolourising syrup by means of ozone?—Chas. Cuningham.

Coal-Tar.—Would any of your readers please state the methods of estimating the amount of benzol, solvent naphtha, burning naphtha, &c., from the results of the analysis of the crude substance, or any work on the analysis of coal-tar.—Young Stillman.

Naphthalene.—Please inform me through your columns of the most important uses at present for naphthalene (pure or crude), also the most direct method for extracting anthracene from heavy oil or pitch, or refer me to any article on the subject that may have been published in the Chemical News.—Miami.

Sulphur Determinations.—I would feel obliged if any of your readers would state what he considers the best and quickest method of estimating sulphide, sulphite, and hyposulphite of sodium in presence of one another in sodium carbonate solution, also a ready method for the qualitative estimation of the latter two in same solution.—B. P.

MEETINGS FOR THE WEEK.

Monday, Feb. 16.—Medical, 8.
— London Institution, 4.
— Society of Arts, 8. Dr. Graham, "On Fermentation."
Tuesday, 17.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
— Civil Engineers, 8.
— Anthropological, 8.
— Zoological, 8.30.
— Society of Arts, 8. Mr. Trelawny Saunders, "On the Present Aspects of Africa, with reference to the Development of Civilised Trade with the Interior."
Wednesday, 18.—Society of Arts, 8. Mr. G. C. T. Bartley, "On Thrift as the Outdoor Relief Test." On this evening the Right Hon. the Earl of Derby will preside.
— London Institution, 7.
Thursday, 19.—Royal Institution, 3. Prof. P. M. Duncan, F.R.S., "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time."
— Royal, 8.30.
— Royal Society Club, 6.
— Chemical, 8. J. Bell, F.C.S., "On the Detection and Estimation of Adulteration in Food and Drink."
Friday, 20.—Royal Institution, 8; Weekly Evening Meeting. Mr M. Vernon Heath, "The Autotype and other Photographic Processes and Discoveries, 9.
— Geological, 1. Anniversary.
Saturday, 21.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

THE CHEMICAL NEWS.

Vol. XXIX. No. 743.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 77).

Preparation of Commercially-Pure Thallium.

(*a*). *From the Flue-Dust of Pyrites-Burners.*—This is by far the most economical source of thallium at present known. In burning thalliferous pyrites for the purpose of manufacturing sulphuric acid, the thallium oxidises along with the sulphur, and is driven off by the heat. If the passage leading from the burners to the leaden chambers is only a few feet long, the greater portion of the thallium escapes condensation, and is carried into the leaden chambers; it there meets with aqueous vapours, sulphurous and sulphuric acids, and becomes converted into sulphate of the protoxide of thallium. This being readily soluble both in water and dilute sulphuric acid, and not being reduced by contact with the leaden sides, remains in solution, and accompanies the sulphuric acid in its subsequent stages of concentration, &c. If, on the other hand, the passage connecting the burners and chambers is 10 or 15 (or more) feet in length, nearly the whole of the thallium is condensed, together with the multiplicity of other bodies which constitute "flue-dust." Accompanying the thallium have been found mercury, copper, lead, tin, arsenic, antimony, iron, zinc, cadmium, bismuth, lime, and selenium, together with ammonia, sulphuric, nitric, and hydrochloric acids. The amount of thallium in these flue-deposits is very various; in many specimens it is not present at all, and in very few it amounts to as much as ¼ per cent, although in some as much as 8 per cent of thallium has been found.

The following is the best plan for extracting thallium from the dust:—The dust is first heated to very dull redness, so as to allow the excess of sulphuric acid to drive off any hydrochloric acid which may be present, and is then mixed in wooden tubs with an equal weight of boiling water, and well stirred; after this the mixture is allowed to rest for twenty-four hours for the undissolved residue to deposit. The liquid is then syphoned off, and the residue is washed, and afterwards treated with a fresh quantity of boiling water. The collected liquors which have been syphoned off from the deposit are allowed to cool, precipitated by the addition of a considerable excess of strong hydrochloric acid, and the precipitate, consisting of very impure chloride of thallium, is allowed to subside. The chloride obtained in this way is then well washed on a calico filter, and afterwards squeezed dry. Three tons of flue-dust treated in this way yielded as much as 68 lbs. of this crude chloride.

The next step consists in treating the crude chloride in a platinum dish with an equal weight of strong sulphuric acid, and afterwards heating the mixture to expel the whole of the hydrochloric acid. To make sure of this, the heat must be continued until the greater part of the excess of sulphuric acid is volatilised. After this the mass of bisulphate of thallium is dissolved in about twenty times its weight of water, nearly neutralised with chalk, and then filtered. On the addition of hydrochloric acid to the filtrate, nearly pure chloride of thallium is thrown down; this is collected on a filter, well washed, and then dried. The crude protochloride of thallium obtained by either of the above methods is added by small portions at a time to half its weight of hot oil of vitriol in a porcelain or platinum dish, the mixture being constantly stirred and the heat continued till the whole of the hydrochloric acid and the greater portion of the excess of sulphuric acid are driven off. The fused bisulphate is now to be dissolved in an excess of water, partially neutralised with carbonate of sodium, and an abundant stream of sulphuretted hydrogen passed through the solution. The precipitate, which may contain tin, arsenic, antimony, bismuth, lead, mercury, and silver, is separated by filtration, and the filtrate is boiled till all free hydrosulphuric acid is removed. The liquid is now to be rendered alkaline with ammonia, and boiled; the precipitate of iron and alumina, which generally appears in this place, is filtered off, and the clear solution evaporated to a small bulk. Sulphate of thallium will then separate out on cooling in the form of long, clear, prismatic crystals. As sulphate of ammonium is much more soluble than sulphate of thallium, the latter can readily be separated from the small quantity of the former salt present. The two salts do not crystallise together.

In order to avoid the inconvenience of driving off the excess of oil of vitriol in the decomposition of chloride of thallium, it is less troublesome, although not quite so economical, to proceed as follows:—Boil the chloride of thallium in solution of sulphide of ammonium for five minutes: decomposition takes place readily. Filter and wash with sulphuretted water till no more chlorine can be detected in the filtrate; then dissolve the sulphide on the filter in dilute sulphuric acid, and treat the solution with ammonia, &c., as above directed.

In order to obtain the metal when working on small quantities of material, sulphate of thallium is dissolved in twenty times its weight of water; the liquid is acidulated with sulphuric acid, and a current of electricity from two or three cells of Grove's batteries is passed through it, platinum terminals being used. The appearance presented when a tolerably strong solution of thallium is undergoing reduction is very beautiful. If the energy of the current bears a proper proportion to the strength and acidity of the liquid, no hydrogen is evolved at the negative electrode, but the metal grows from it in large, crystalline, fern-like branches, spreading out into brilliant metallic plates, and darting long needle-shaped crystals, sometimes upwards of an inch in length, towards the positive pole, the appearance being more beautiful than with any other metal. Some of the tabular crystals, as seen in the liquid, are beautifully sharp and well defined; considerable difficulty, however, is met with in disengaging them from the electrode, and removing them in a perfect state from the liquid. So long as thallium is present in the solution, no hydrogen is evolved with a moderate strength of current; as soon as bubbles of gas are evolved, the reduction may be considered complete. The crystalline metallic sponge may now be squeezed into a mass round the platinum terminal, disconnected from the battery, quickly removed from the acid liquid, rinsed with a jet from a wash-bottle, and transferred to a basin of pure water. The metal is then carefully removed from the platinum, and kneaded with the fingers into as solid a lump as possible. It coheres readily by pressure, and will be found to retain its metallic lustre perfectly under water.

When considerable quantities of thallium are to be reduced to the metallic state, it is convenient to employ metallic zinc for the purpose. In the course of twenty-four hours I have reduced upwards of a quarter of a hundredweight of the metal in the following way:—Plates of pure zinc (which should leave no residue whatever when dissolved in sulphuric acid) are arranged vertically round the sides of a deep porcelain dish holding a gallon. Crystallised sulphate of thallium, in quantities of about 7 lbs. at a time, is then placed in the dish, and water poured over to cover the salt. Heat is applied, and in the course of a few hours the whole of the thallium will be reduced to the state of a metallic sponge, which readily separates from the plates of zinc on slight agitation. The liquid is poured off, the zinc removed, and the spongy thallium washed several times. It is then strongly compressed between the fingers, and preserved under water until it is ready for fusion.

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* A Paper read before the Royal Society June 20, 1872.

The metal is readily obtained in the coherent form by fusing the sponge. This is most conveniently performed under cyanide of potassium on the small scale, and under coal-gas when working with large quantities. In the former case, the sponge, strongly compressed and quite dry, is broken into small pieces, which are dropped one by one into cyanide of potassium kept fused in a porcelain crucible. They rapidly melt, forming a brilliant metallic button at the bottom. When cold, the cyanide of potassium may be dissolved in water, when the thallium will be left in the form of an irregular lump, owing to its remaining liquid and contracting after the cyanide has solidified. On the large scale, the fusion is best effected in an iron crucible. This is placed over a gas-burner, and a tube is arranged so that a constant stream of coal-gas may flow into the upper part of the crucible. Lumps of the compressed sponge are then introduced, one after the other as they melt, until the crucible is full of metal. It is then stirred up with an iron rod, and the thallium may either be poured into water and obtained in a granulated form, or cast into an ingot. Thirty or forty fusions have been performed in the same crucible without the iron being appreciably acted upon by the melted thallium.

(*b*). *From Iron Pyrites.*—The richest pyrites which I have yet met with comes from Oneux, near Theux; it contains about 1 part of thallium in 4000. Two tons of this ore were worked in the following manner:—

The pyrites, broken up into pieces of the size of a walnut, is distilled in hexagonal cast-iron pipes, closed at one end, and arranged in a reverberatory furnace. Conical sheet-iron tubes are luted on to the open ends, and the retorts are kept at a bright red heat for about four hours. At the end of the operation, the receivers are found to contain from 14 lbs. to 17 lbs. of dark green- or grey-coloured sulphur for every 100 lbs. of ore used. The whole of the thallium originally in the pyrites will be found in this sulphur, from which it has now to be separated. The sulphur may be dissolved out by means of bisulphide of carbon, which leaves the sulphide of thallium behind, or it may be extracted by boiling with caustic soda. The former plan occasions less loss of thallium, but, owing to the inconvenience of working with large bulks of bisulphide of carbon, the soda process is preferable. 12 lbs. of caustic soda, 18 lbs. of the thalliferous sulphur, and 1½ gallons of water are boiled together till the sulphur has dissolved; 6 gallons of water are added, and the clear liquid, when cool, is decanted from a voluminous black precipitate, which has been separated from the sulphur. The precipitate is then collected on a calico filter, and washed. It contains the greater portion of the thallium in the form of sulphide, together with iron, copper, mercury, zinc, &c. Some thallium, however, remains dissolved in the alkaline liquid, and is lost. The black precipitate is then dissolved in hot dilute sulphuric acid, to which a little nitric acid is added, and the liquid is diluted with water, and filtered. Hydrochloric acid and a reducing agent, such as sulphite of sodium, will now throw down the nearly insoluble white protochloride of thallium, which is to be filtered off and washed.

(*c*). *From Sulphur or Pyrites in the Wet Way.*—The material is boiled in nitro-hydrochloric acid until nothing but bright yellow sulphur is left; water is then added, and the filtrate is evaporated with sulphuric acid until it is nearly dry, and sulphuric vapours are copiously evolved. The residue is dissolved in a large excess of hot water, and carbonate of sodium is added to alkaline reaction, and then cyanide of potassium (free from sulphide of potassium). The liquid is then heated gently for some time, and filtered. The precipitate contains the whole of the lead and bismuth which may be present, as carbonates, whilst the thallium is in solution. A current of sulphuretted hydrogen being now passed through the alkaline liquid precipitates all the thallium, whilst the copper, antimony, tin, and arsenic remain dissolved. The precipitated sulphide is filtered off, washed, and dissolved in dilute sulphuric acid, and the thallium is precipitated by means of hydrochloric acid as chloride, from which the metal is extracted in the way previously described.

(*d*). *From the Saline Residues of the Salt-Works at Nauheim.*—Dr. Böttger adds an insufficient quantity of bichloride of platinum to the strong solution, and boils the precipitate five or six times with three times its weight of water. The insoluble residue consists of the platinum salts of cæsium, rubidium, and thallium. Upon boiling these with a weak solution of potash and a little hyposulphite of sodium, the solution soon becomes clear, whereupon cyanide of potassium and sulphuretted hydrogen are added. This precipitates the thallium as sulphide. The liquid is then to be filtered, the residue washed and dissolved in sulphuric acid, and the metal precipitated by metallic zinc.

(*e*). *From Commercial Hydrochloric Acid.*—Many samples of yellow hydrochloric acid contain thallium. It may be separated by neutralising with an alkali and adding sulphide of ammonium. The black precipitate contains the thallium, together with iron and some other metallic impurities of the acid. It is to be dissolved in sulphuric acid, and the thallium precipitated with hydrochloric acid as protochloride. This is afterwards reduced as already described.

(*f*). *From the Mother-Liquors of the Sulphate-of-Zinc Works at Goslar.*—Each kilogramme of these liquors is said to yield as much as half a gramme of chloride of thallium. A sheet of zinc is plunged into the liquid, whereby the thallium, copper, and cadmium are precipitated. The metallic sponge is then removed from the zinc, washed, and treated with cold dilute sulphuric acid, which dissolves the cadmium and thallium with disengagement of hydrogen, whilst the copper is left behind. The filtrate from the copper is then mixed with hydrochloric acid, which precipitates the nearly insoluble chloride of thallium. If only a small quantity of thallium is present, iodide of potassium may be used as a precipitant, as the iodide of thallium is insoluble in water.

(To be continued).

ESTIMATION OF MANGANESE IN SPIEGELEISEN.

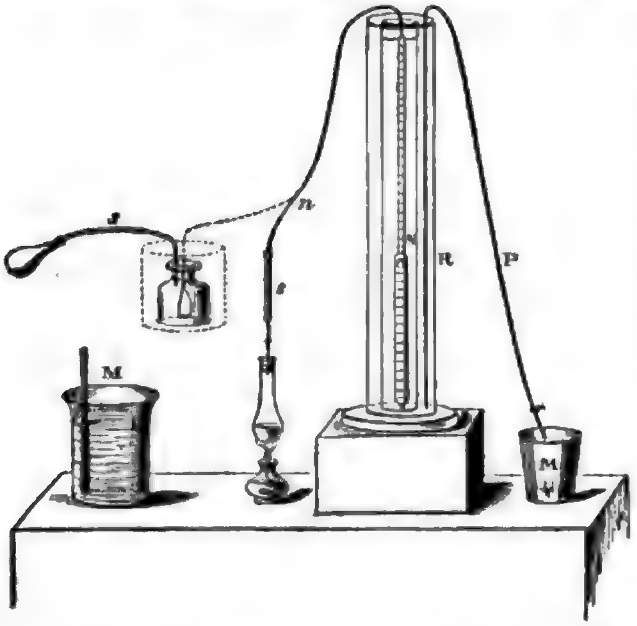
By JOHN PARRY.

The ordinary method of separating MnO from Fe_2O_3 is by precipitating the latter with ammonia and sodic acetate, retaining MnO in solution, to be estimated by precipitation with bromine and ammonia. Manganese may thus be very accurately estimated, yet it is difficult to ensure the perfect separation of MnO from Fe_2O_3; the presence of the latter in solution is easily detected, but it is well known that it is difficult to obtain the Fe_2O_3 precipitate free from traces of manganese, and it is necessary to redissolve the Fe_2O_3 precipitate, and boil afresh with sodium acetate; in most instances, a further notable quantity of manganese is found. On the whole, the process is a very slow one, requiring more time and attention than can well be spared in a busy laboratory where frequent and rapid manganese estimations are called for.

It occurred to the author that Fresenius and Will's method—in which the quantity of MnO_2 in manganese ore is determined by the amount of CO_2 evolved on treatment of the ore with sulphuric acid and sodium oxalate—might be applied to the estimation of manganese in spiegeleisen, provided the latter could be obtained in the form of a dry oxidised product containing always a definite manganese oxide, either MnO_2 or Mn_2O_3. After many trials, the following process was found to give good results:—

0·5 grm. spiegeleisen dissolved in nitric acid (sp. gr., 1·2), and evaporated to dryness in a small pear-shaped glass flask, and, lastly, heated to redness over a small Bunsen's burner for ten minutes, the flask and its contents allowed to become quite cold, sodium oxalate and hydrochloric acid added, and the flask, &c., quickly connected with the apparatus for collecting and measuring the CO_2 evolved;[*] the glass cylinder, R, and graduated tube, C, having been previously filled with mercury, by pouring mercury into R, thence rising in C, which is open at the bottom. The flask is gently heated until a clear solution is obtained; the CO_2 generated passes into the tube, C, as shown. As the gas passes into C, the top of the syphon, P, is opened, and the mercury run out into M. The mercury in C and R must be kept at about the same height, otherwise the india-rubber cork closing the flask may be blown out. When sufficiently cool, the flask is plunged into water, and allowed to remain there not less than ten minutes, until the water has attained the same temperature as that in glass cylinder, N, enclosing the gas-tube. Mercury is poured into R until the mercury in C and R stands at the same height, the number of divisions of CO_2 evolved read off noting the temperature of the water in N and M, also the height of the barometer.

The gas-tube used by the author is graduated in m.m.—the upper smaller part, about 300 m.m. = 30 c.c. capacity, the wide lower part, about 150 m.m. = 50 c.c. capacity. These are only approximate. Of course, each tube must be carefully calibrated previous to use, and the value of each division determined. The number of c.c. CO_2 (B., 760; T., 0°) being known, it is easy to calculate the corresponding quantity of manganese—



87 parts by weight $MnO_2 = 88$, $CO_2 = 55$ manganese.

It was, however, found impossible to obtain a product containing MnO_2. Although many experiments were made with this object, heated over the Bunsen's burner as previously described, the manganese was always present as Mn_2O_3, and further heating for thirty minutes showed no loss of oxygen. Consequently, 88 parts CO_2 represented 110 metallic manganese. Example—

0·5 grm. spiegeleisen gave CO_2 ..	31·80 c.c.
Temperature	19·00°
Barometer	738·00 m.m.
Tension of aqueous vapour ..	16·36 „

$$\frac{31{\cdot}8 \times 721{\cdot}64}{760 \times (1) + (0{\cdot}003665 \times 19)} = \frac{28{\cdot}22 \text{ c.c. } CO_2 \times 0{\cdot}1966 \times 110}{88} =$$
$$= 0{\cdot}06934 \text{ grm. Mn.}$$

Manganese .. .. 13·868 per cent.

The above calculations appear rather tedious, but it is evident the calculation takes less time than when manganese is estimated by precipitation, the latter process requiring at least six hours, and in most instances a much longer time. Also the calculation may be simplified by the use of the tables given in Sutton's "Volumetric Analysis," where the divisor for the formula—

$$\frac{V \times B}{760 \times (1 \times \delta T)}$$

is given. Also the value of 1 c.c. of CO_2 shown by the instrument may be expressed in parts by weight of Mn. Thus, 28·22 c.c. CO_2 = 0·06934 grm. CO_2; therefore, 1 c.c. = 0·00245716 grm. Mn, which, multiplied by x c.c. CO_2 found, gives at once the corresponding amount of manganese.

Test Experiments—

0·500	grm.	spiegeleisen		gave	28·20	c.c. CO_2 =	13·860 %	Mn
„	„	„		„	28·05	„ =	13·800	„
	By weight—Manganese						13·740 %	
0·500	grm.	spiegeleisen	(1)	gave	23·57	c.c. CO_2 =	11·600 %	Mn.
„	„	„	(2)	„	„	„	„	„
„	„	„	(3)	„	„	„	„	„
„	„	„	(4)	„	„	„	„	„
„	„	„	(5)	„	„	„	„	„
0·253	„	„		„	11·70	„	11·500	„
0·264	„	„		„	12·60	„	11·350	„
0·250	„	„		„	11·80	„	11·590	„
1·000	„	„		„	47·00	„	11·547	„
	By weight						11·530	„

By substituting water for mercury, and connecting the tube, *n*, with a bladder, &c., immersed in a large beaker of water, as shown by the dotted lines (see Fresenius's "Analysis," 5th ed., p. 152), results sufficiently accurate have been obtained, and the trouble and expense of the use of mercury obviated. The apparatus becomes a modification of Schiebler's, and may be used for the same purpose, also applied to the determination of CO_2 in limestone, ores, &c.

The above method of analysis only occurred to the author after a perusal of a paper written by Dr. Russell on the measurement of gases as a branch of volumetric analysis; previously attempts were made according to Bunsen's method, in which the chlorine resulting from the decomposition of MnO_2 or Mn_2O_3 by HCl is passed into iodide of potassium solution, and the liberated iodine titrated with hyposulphite of sodium; this method, however, did not give good results.

Note.—This method has been applied to the determination of manganese in steel, treating not less than 4 grms. steel, and measuring over mercury. The dry product requires a rather stronger heat, best accomplished by heating over a small Bunsen's burner in an open platinum capsule. It is best to take 10 grms. steel, and evaporate to dryness in a porcelain dish, and heat a weighed portion of the dry residue as above, reserving part for a second trial.

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL,

IN CONNECTION WITH THE

SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

(Continued from page 80).

Crossley Brothers, of Manchester, exhibit an Atmospheric Gas Engine. This engine works as follows:—Gas and air, mixed in such proportions as to give a mild explosive compound, are admitted under a piston which slides air-tight in a vertical cylinder open at the top. The compound is ignited, explodes, and the explosion drives the piston upwards. The ignited gases, having increased in volume, lose their heat; their pressure becomes less as the piston rises, and when it has got to the top of the cylinder a partial vacuum is formed, and the pressure of the atmosphere makes the piston descend. The work thus done steadily by the atmosphere during the return stroke of the piston yields the driving power, which is tranferred to the shaft by suitable mechanism. This utilisation of the instantaneous power of the explosion, by allowing the piston to fly up freely from it without doing other work than emptying the cylinder of air, is the basis of the economy and success of these engines. The sudden energy of an explosion cannot be economically applied to push a piston slowly along against a load, as in the case of steam-engines; it is thus that other gas engines have been superseded by this patent. Some of the advantages of this engine, compared with steam engines, are, that it can be started at a moment's notice, and will at once give out its full power; thus no time is lost in waiting to get up steam. The attendance required is exceedingly small, averaging one hour per day for a man, including cleaning, oiling, stopping, and starting. The fuel has not to be got into the house, nor ashes to be got out; gas is said on, thus much trouble is saved. No constant supply of water is required; a quart a day suffices. Gas at 4s. per thousand feet will feed the engine at one penny an hour per horse-power. Gas can only be burnt in exact proportion to the power required; this is controlled by a governor. These engines cannot be used for high horse-power; from one to two horse-power is the most they can be used for. From the many testimonials received, it seems that that the cost of gas is less than one penny per hour.

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[*] A small chloride of calcium tube is attached here (see sketch).

The show of fire-grates, kitchen ranges, various kinds of coal savers, is very good, and perhaps the most complete in the Exhibition. The grates, &c., are all in use in the third annexé of the building, so that spectators can judge for themselves as to the relative merits of the various inventions. What would have made this show still more interesting would have been to have given the weight of coal consumed by each fire during the day to produce the desired effect; as it is, one sees an interesting collection of machines for saving fuel, but no experiments seem to have been performed by competent judges to test the truth of each inventor's statements. There are various grates for utilising the waste heat of the fire and causing it to warm air chambers, which warm air is carried to different rooms in the house.

Shillito and Shorland exhibit patent grates and hot-air boxes for extracting waste heat from every description of grates and kitchen ranges, thereby effecting a saving of at least 50 per cent in fuel, without at all interfering with the general appearance of grates. One of their 30s. boxes can be inserted behind register or sham register stoves now in use, and could also be placed behind a kitchen fire without taking down the range or grate, and, according to the inventor's statement, will raise temperature in excess of external atmosphere from 10° to 20°, and discharge into room or lobby 2000 cubic feet of warm air per hour. The advantages of this fire-box grate over the ordinary grate are, that it secures a supply of perfectly fresh, warm, pure air, and diffuses it equally over the whole room, or rooms requiring to be heated, the cold air admitted from the outside being perfectly fresh, and warmed by passing over the inside back of the grate. The objection to other hot-air stoves, that they draw their supply from the already vitiated air of the room, is obviated. When this grate is used in dwelling-houses two rooms can be heated by the same fire—the open fire serving for one room, and the heated fresh air being thrown into the next.

Thomas Whitwell exhibits a grate on a similar principle. By his fire-place he injects warm air into the room at a temperature between 65° and 115° F.

Rogerson and Co. show Corbitt's Improved Economic Warming and Ventilating Grate. It is simple in construction. The best points of the modern grate are preserved, viz.:—The cheerful open fire; large reflecting and radiating surface; reduced size of fire-box, with convex back, which is composed of fire-brick, and, being a bad conductor, throws the heat into the room; the draught-flue, opening into the chimney, is regulated by Louvre valves, so that no waste heat need pass up the chimney beyond the products of combustion.

The most succesful and ingenious fire-grate in the Exhibition is the invention of the Rev. J. Wolstencroft, and is called the Vacuum Draught. The inventor says the great difficulty is solved, viz., "how to get a healthy, cheerful fire, imparting a genial heat, with half the amount of fuel commonly used." We saw the grate in use, and we must candidly admit it was the most cheerful and the brightest fire in the place, but as to the amount of coal it daily consumed we are unable to say. According to some experiments which have been performed with it by James D. Curtis, Commander Royal Navy, there is truth in the inventor's statement, that there is a great economy in the consumption of fuel. Captain Curtis, of Brimpsfield, Gloucester, experimented with the grate in his harness-room from the 18th of August, 1873, to the 1st of September, 1873, using no other fire, burning slack coal delivered for 24s. per ton, employing this fire daily for cooking small things, such as boiling potatoes for the fowls, &c., and after the daily use the fire was left to burn itself out during the night; the cost of coal per day was 3¼d. The front of the grate is continued down to the floor, cutting off the supply of air from within the room; by this means an air chamber is formed under the grate, to which the air is communicated from within or without the building, bringing the draught under and directly through the fire-bars. In a fire-grate which has been fitted up in Manchester, at the office of one of the Local Boards, the air-chamber communicates with the main sewer, and draws its supply from thence, thus, as it is supposed, ventilating the sewer, at the same time consuming the noxious sewer gases. Any kind of fuel can be used, and very small coal can be burnt as easily and with as good results as lumps; coke and cinders may be burnt over and over again, until they become as fine as sand. The ashes from the fire all drop through the bottom of the grate into or through the air chamber, consequently dust from the fire is greatly diminished in the room; the draught may be regulated at pleasure with a valve. The invention may be easily applied to many existing grates at the cost of a few shillings.

By the side of Wolstencroft's fire-place was Kenyon's Patent Coal Saver, which consists of a perforated fire-brick tile, to put into the grate and fill up the coal space, throwing the hot coals to the front of the fire-place, while the back of the fire is comparatively cold. It has the disadvantage of presenting a very dull fire while it is carrying out its principle of saving coal, presenting a great contrast to Wolstencroft's; indeed one might almost think it was placed there as a foil for his more successful competitor.

Crawshaw's Household Coal Saver is a corrugated piece of iron or clay placed behind an ordinary coal-fire. It radiates the heat from the fire into the room, instead of allowing so much waste heat to pass up the chimney.

Frisbie's Patent Feeder and Grate is a most ingenious arrangement for feeding a fire with coal from the bottom. This feeder and grate provides a simple method of feeding fuel up, from underneath the fire, into all descriptions of furnaces, fuel-boxes, and fire-grates. By this principle of feeding from below the fire there is no fresh consumption of the fuel, the igniting of the fresh coal is a gradual process, while at the same time a very intense heat is obtained. The hottest portion of the fire being constantly at the top utilises the heat, and preserves the fire-bars from being burnt out; the heat of the surface of the fire is not abated by the supply of fresh fuel, and no cold air is admitted to the furnace while feeding, thereby preserving a perfectly uniform heat. By feeding from beneath, the coal is pushed up and outwards equally from the centre of the grate, and is evenly consumed, with scarcely any refuse except fine ashes, which drop down through the grate-bars without raking. From various testimonials which the inventor has received, it seems that there is a great saving in the use of the coal; thus one firm says their coal bill averaged £160 a month, but on introducing one of these burners they only used that quantity in four months.

Folloms and Bate, of Manchester, exhibit a large collection of stoves and fire-grates. One of their novelties is a Portable Water-Boiler, which consists of an upper and lower chamber, and is so constructed that the upper chamber is filled with cold water, and as the hot water is drawn off from the lower, the cold water is allowed to fall down through a small pipe, so that there is a constant supply of warm water. It will boil 11 gallons in 20 minutes, or three or four hundred persons can be supplied with hot water for tea at a cost of 3 lbs. of coal.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 13th, 1874.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. Rooke Pennington, of Bolton, was elected an ordinary Member of the Society.

A drawing was shown representing some further improvements of Dr. Joule's mercurial air exhauster, described in the *Proceedings* of February, 1873.

In the section represented by Fig. 1, w w is a wooden frame; P a pulley for raising or lowering a flask of mercury held in a wooden box, M, working in a slide; *s, s, s, s* are india-rubber stoppers; E is the exhauster; *t, e,* the entrance and exit tubes; *g* the gauge; *f* a funnel to admit sulphuric acid; B, B, movable brackets to support any apparatus.

In Fig. 2 the exhauster is drawn to a larger scale. *t, e* are the entrance and exit tubes, fitting tightly in an india-rubber disc, *a*, which disc is kept tightly pressed against the exhauster by means of the ring, *b, b*. The mercury is represented sunk below the entrance tube, as is the case when the movable flask is in its lower position. On raising the flask by means of the pulley, the mercury rises in the exhauster and forces any air it may contain into the upper part of the exhauster by raising the india-rubber plug. The air then makes its exit through the pipe *e*. This latter is also used for withdrawing the acid which gradually accumulates.

Fig. 3, also drawn to a large scale, represents a convenient means of introducing sulphuric acid for removing aqueous vapour, or to let air into the apparatus. The orifice at the bottom of the funnel is about 1-100th of an inch diameter, to prevent violent action.

It may be useful to mention that the junctions are made with black india-rubber tube fastened by softened iron wire.

"*On the Influence of Acids on Iron and Steel,*" by William H. Johnson, B.Sc.

In a paper published in the *Proceedings* of the Society for March 4th, 1873, I mentioned that if a piece of steel wire be immersed in hydrochloric or sulphuric acid for ten minutes or more, and then well washed with water and dried, that on breaking it bubbles were not seen to rise through the moisture on the surface of the fracture as was the case with *iron* wire. Subsequent experiments made under the microscope with a power of 250 diameters, however, show that very small bubbles are given off with great rapidity, sometimes from the whole, sometimes from part only, of the fractured surface.

This difference in the behaviour of iron and steel is most likely connected with the difference of molecular structure. Thus the fracture of a steel wire containing, say, 0·75 per cent of carbon, when seen under the microscope presents a tolerably flat surface, composed of innumerable small, sharp crystalline points, while that of iron is rough, more or less fibrous or mossy, and the fibres do not end in sharp points. These fine crystalline points in the steel, as is well known, must facilitate the evolution of bubbles; consequently they are very small, rapidly given off, and hence invisible to the naked eye, whilst the absence of these points in iron causes the small bubbles to collect into larger ones, which are readily seen.

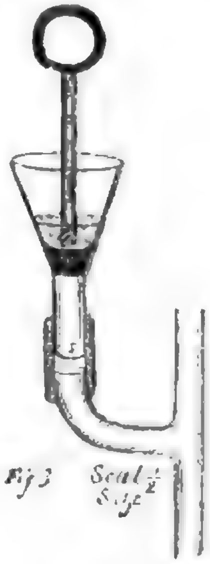

Fig 3 Scale ½ Size

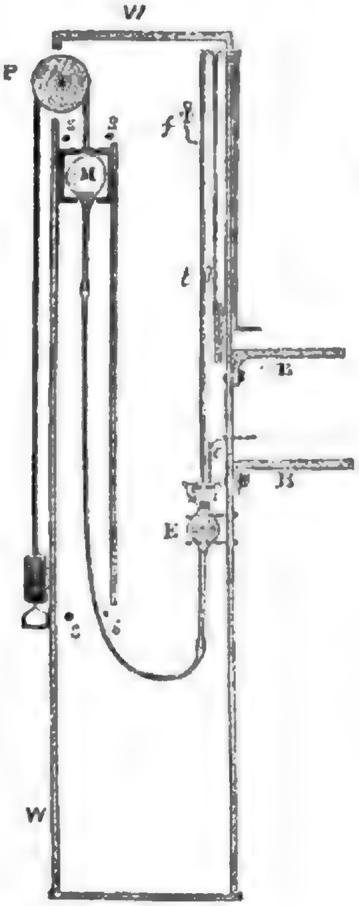

Fig1. Scale 1/24

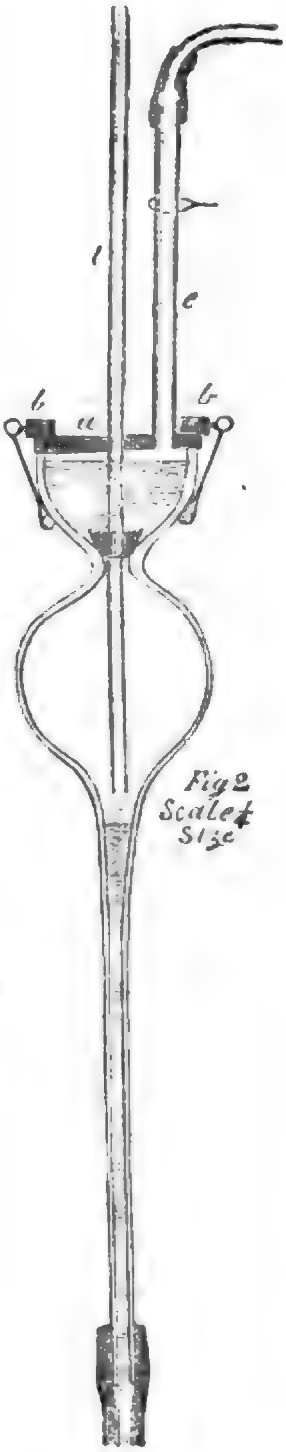

Fig 2 Scale ¼ Size

The less carbon a steel contains the more its fracture will resemble iron, so in a steel containing only 0·21 per cent of carbon small bubbles may sometimes be seen by the naked eye.

About 5 ozs. of iron wire 0·125 in. diameter, after ten days' immersion in hydrochloric acid 1·20 sp. gr., was well washed in water, dried and placed in a glass tube heated to a temperature of a little over 100° C. by a sand-bath. Each end of the tube was connected with a bottle containing nitrate of silver solution. A current of air was then slowly drawn through the tube for two to three hours without forming any precipitate, however, of chloride of silver; but the surface of the iron was covered with a coating of oxide, or, in all probability, oxychloride of iron.

Thick pieces of iron, 0·450 in. diameter, were found to redden blue litmus-paper slightly when applied to the fracture after the iron had been immersed twelve hours in hydrochloric or sulphuric acid.

Mr. J. Carter Bell communicated a series of meteorological observations which have been made daily during the months of May, June, July, and August, 1873, at Tumaco, New Granada, South America, by Mr. G. Wilcynski.

"*On Crystalline Sublimed Cupric Chloride*," by S. Carson (Student in the Chemical Laboratory of the Owens College).

Cupric chloride, prepared by burning copper in dry chlorine gas, or by heating the anhydrous salt to 200°, is obtained either as a brown sublimate or as a brownish yellow powder.

A mass of a copper compound, crystallised in needles, many exceeding 5 m.m. in length, as found in the decomposer of the Deacon chlorine process, was forwarded to Professor Roscoe by Mr. Worsley, of the Netham Chemical Works. The crystalline mass was collected from the space above the marbles, impregnated with copper sulphate at the top of the compartments. The temperature of this space is always necessarily a little lower than that of the spaces between the marbles where the action takes place, and to this is attributed the deposition of the compound.

I have made several analyses of these crystals, the results of which show that they consist of anhydrous cupric chloride, mixed with a small quantity (about 2 per cent) of an insoluble oxychloride. The following is a mean of several analyses of the soluble portion:—

	Calculated.	Found.
Copper	47·172	46·909
Chlorine.. ..	52·828	53·091
	100·000	100·000

The formation of this crystalline sublimate appears to take place as soon as the temperature of the marbles covered with sulphate of copper reaches about 800°. In all probability a formation of copper chloride is constantly occurring as a necessary step in the decomposition of the hydrochloric acid and air, and when the temperature reaches the volatilising-point of the chloride these crystals appear.

As the greatest amount of decomposition of the hydrochloric acid takes place close upon the temperature at which the chloride sublimes, the formation of this salt and the consequent loss of copper has been a fertile source of annoyance to the manufacturer.

Mr. Deacon has recently completely overcome this difficulty by the addition of sodium sulphate to the copper sulphate with which the marbles are impregnated.

The presence of this salt prevents any formation of copper chloride, sodium chloride being volatilised, and copper sulphate remaining behind. This reaction is well seen by the change of colour from green to blue, produced when a solution of sodium sulphate is added to one of cupric chloride.

CORRESPONDENCE.

PINK AND WEBSTER'S "ANALYTICAL CHEMISTRY."

To the Editor of the Chemical News.

Sir,—Amongst the various books on chemistry which have recently appeared, my attention has been called to a work entitled "A Course of Analytical Chemistry (Qualitative and Quantitative), by William W. Pink, Practical Chemist and Metallurgical Analyst, and George E. Webster, Lecturer on Metallurgy and the Applied Sciences, Nottingham." The value of this work, which forms a portion of Weale's Educational Series, will be appreciated after a perusal of a few extracts.

On p. 42, we learn, under the head of Reagents, the following property of "baric chloride, $BaCl_2$":—"The solution of this salt must be neutral after precipitation of SO_2HO_2, sulphuric acid."

We are next told (p. 43) that "$CONaO_2$, sodic carbonate, must completely volatilise." It would be interesting to know at what temperature this phenomenon takes place.

As specimens of the lucid English with which the work abounds, I may quote from p. 121, Manufacture of Oxygen—"a little MnO_2, manganic oxide, or Fe_2O_3 (peroxide, sesquioxide, or red oxide of iron) added, reduces the heat required for the giving off of the oxygen, but is liable to contaminate it by traces of Fe or Mn and from potassic chloride." The conclusion of this sentence seems unintelligible.

Again, on p. 129, we have "measuring-flask can be more easily obtained than made." . . "If, however, the student has some practice in manipulating, measuring-flasks are simple articles."

On p. 123 the following statement occurs:—"Copper is prepared by the electrotype method, or by precipitating the metal from a solution of sulphate, and then freeing from iron by boiling in hydrochloric acid, after which wash, dry, and roll into sheets." Anyone who has seen the pulverulent condition of copper deposited from solution by the action of iron will appreciate the difficulty attending the process of rolling it into sheets.

I must now turn to the quantitative portion of the work, and may premise by saying that most of the processes recommended pre-suppose that the operator has a solution of the substance to be estimated entirely free from other salts; this is surely a condition rarely met with by the analyst. The most frequent, and indeed almost universal, method of estimation appears to be—"add sulphuric acid, evaporate to dryness, and ignite." This is apparently applicable to the determination of barium, strontium, magnesium, sodium, potassium, calcium, and lithium; whilst the estimations of magnesium as pyrophosphate, and of potassium as a double chloride of platinum and potassium, are entirely omitted.

In that portion of the work treating of the "Estimation of Non-Metals," we have (p. 166) an account of the means to be employed for the conversion of sulphur into sulphuric acid, but nothing is said with regard to estimation. On the same page, we are instructed to "evaporate to dryness and then heat gently to dryness."

In the estimation of copper as cupric oxide, the student is told (p. 148), with regard to the precipitate to "ignite intensely, and weigh as soon as cool." . . "If the solution, however, be ammoniacal, the precipitate must be weighed whilst hot, as, if allowed to cool, a small portion of the precipitate would re-dissolve." I should be glad to learn in what the precipitate is to re-dissolve after intense ignition.

In conclusion, I may give one more extract. In speaking of chloride of silver, the authors state that, "when the chloride is thoroughly dry, an ejection often takes place, occasioned by the silver imbibing oxygen and then allowing it to escape (called occultating)."—P. 145.

I only call attention to a few of the worst blunders, and would ask the probable results of a student's efforts in pursuit of knowledge were he to follow the recommendation of the authors (preface) to "practically follow the course as laid down."—I am, &c., A. G. P.

ESTIMATION OF SILICON AND GRAPHITE IN PIG-IRONS.

To the Editor of the Chemical News.

SIR,—It seems to me that the method of estimating silicon and graphite in pig-irons which is described by Mr. Piesse in the CHEMICAL NEWS, vol. xxix., p. 57, is open to objection on the following grounds:—The original action of the sulphuric acid on the silicide of iron results in the formation of a partially oxidised compound of silicon (probably leucon), and, unless this is completely oxidised to silica by the treatment with nitric acid, the loss on ignition will be too low (and, therefore, the graphite estimation erroneous), to say nothing of the indefinite amount of water retained by the leucon. Indeed, it seems to me very unsafe to assume that silica dried at 100° C. always contains 6 per cent of water, though I certainly have never attempted to ascertain the composition of such silica. Mr. Piesse's method also involves the drying of a weighed filter, always an objectionable process. When the iron contains combined carbon as well as graphite, there is great danger of some of the former producing an insoluble compound and remaining with the silica and graphite, thus increasing the apparent amount of the latter. Evaporation with nitric acid does not destroy this carbonaceous body, but it can be dissolved by alkalies.

I presume Mr. Piesse's experience has been chiefly confined to the analysis of irons containing but little graphite, or he would scarcely speak of burning it off in "two or three minutes in a muffle," even in the presence of the silica.

The determination of graphite and silicon being an every-day matter in Sheffield, I have taken some trouble to ascertain the method by which accurate results could be obtained most rapidly. The process adopted is not novel, except in one or two minor details. The results often agree to the second place of decimals.

The iron is just covered with water, and treated with hydrochloric acid of sp. gr. 1·11. The liquid is boiled for about half an hour, when the iron (if grey) is entirely dissolved, the silicon being chiefly converted into leucon, which floats on the surface as a very bulky white mass. The liquid is diluted with hot water, filtered, and washed first with acidified, and then with pure, water. The residue is next washed off the filter (a very easy operation) into a large silver or platinum crucible, in which is placed a lump of pure hydrate of potassium about equal in weight to the iron taken. The leucon dissolves, with evolution of hydrogen and formation of soluble potassium silicate, while any carbonaceous compounds also pass into solution with brown colour. The liquid is heated nearly to boiling for a short time, diluted, and filtered. The filtrate is added to the acid solution of the iron, evaporated to dryness, &c., and the silica obtained calculated into silicon. The graphite on the filter is washed off, boiled with a little aqua regia to dissolve any iron which may have previously escaped solution (as is often the case with spiegeleisen and white irons generally), the liquid again filtered, the graphite washed, and rinsed off into a platinum crucible, where the water is evaporated to dryness, and the graphite strongly dried. The graphite so obtained is nearly pure, but I always burn it away, and take the loss on ignition as the true amount. If a large residue (more than 0·1 per cent of the iron taken) is left after ignition, the result is not reliable, the tendency being to render graphite estimation too *high*. The error seems to be due to the formation of an oxychloride of iron, decomposed on ignition, with production of volatile ferric chloride, thus increasing the loss of weight. It is only by very bad management such an accident can occur. In iron containing much titanium, the residue left after combustion of the graphite may be very considerable without affecting the accuracy of the results. The residue never contains silicon.

The above method will doubtless take longer in the execution than that recommended by Mr. Piesse, but it is free from the serious sources of error of the latter process, and gives remarkably concordant results in practice.

With respect to the method of determining sulphur recommended by Mr. Piesse (vol. xxviii., p. 248), I may say that the analyst who follows the instructions there given will infallibly get too low a result, on account of the time allowed by Mr. Piesse (twelve hours) being quite insufficient for the perfect precipitation of the barium sulphate. The presence of excess of hydrochloric acid, which will certainly be present if Mr. Piesse's directions are followed, greatly retards, if it does not altogether prevent, the precipitation of $BaSO_4$, and if Mr. Piesse carefully neutralises his filtrate with ammonia, and allows it to stand another twenty-four hours, he will find a considerable additional precipitation of barium sulphate will take place. For the complete precipitation of the very small quantities of sulphur present in iron, it is necessary to neutralise the liquid as closely as possible with ammonia before adding barium chloride, and to allow twenty-four or thirty-six hours for the precipitation.—I am, &c.,

ALFRED H. ALLEN.

SULPHATE OF AMMONIA.

To the Editor of the Chemical News.

SIR,—The letter of "J. B. S." (vol. xxix., p. 71) strikes at an existing evil, but I think not at the root of it. It would be preferable to advise those engaged in the manufacture of sulphate of ammonia to make sulphate of ammonia instead of acid sulphate of ammonia. The former being rapidly crystallised from a slightly alkaline solution requires no drying, and contains its proper percentage of ammonia, and will not absorb moisture from the atmosphere. Whilst the latter allowed to crystallise slowly from an acid solution, even if dried, will not contain its proper percentage of ammonia, and will be ever ready to absorb moisture. Thus the cause of our wet sulphate of ammonia appears to rest more with the manipulation than with the "hasty packer," though insufficient draining may frequently occur and tell upon the balance.—I am, &c., G. J. S.

PRODUCTION OF AMMONIA.

To the Editor of the Chemical News.

SIR,—In your last issue you describe a process for the production of pure ammonia by reducing a nitrate with sodium amalgam. I believe this method was first suggested by me in the CHEMICAL NEWS, vol. xviii., p. 179, as a means of detecting nitric acid in potable waters, though no doubt this fact had escaped your observation, the reaction being indeed sufficiently obvious.—I am, &c.,

THOMAS P. BLUNT, M.A. Oxon, F.C.S.

Physical Society.—A numerously-attended meeting was held on Saturday last in the Physical Laboratory at the Science Schools, South Kensington, for the purpose of establishing a Physical Society in London. The chair was taken by Dr. J. H. Gladstone. The bye-laws prepared by the Organising Committee appointed on Nov. 29 were received and amended. The following were chosen officers for the first session:—*President*—Dr. J. H. Gladstone, F.R.S. *Vice-Presidents*—Prof. W. G. Adams, F.R.S., and Prof. G. C. Foster, F.R.S. *Secretaries*—Prof. E. Atkinson, and Prof. A. W. Reinold. *Treasurer*—Prof. E. Atkinson. *Demonstrator*—Prof. F. Guthrie. *Other Members of Council*—W. Crookes, F.R.S., Prof. A. Dupré, Prof. T. M. Goodeve, M.A., Prof. O. Henrici, B. Lœwy, Dr. E. Mills, and H. Sprengel.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 29, 1873.

Researches on Isomerism in Albumenoid Substances.—M. A. Bechamp.—The author having studied the products of the oxidation of albumenoid bodies by permanganate of potassa, had occasion to determine the rotatory power of white of egg. This was comprised between 40° and 42° to the left. Among the products of the oxidation of this albumen were certain compounds possessing an acid reaction, whose rotatory power, in the same direction, amounted to 43°, 49°, 52°, and even 56°. It was evident that the white of egg contained several albumenoid bodies possessing unlike rotatory powers. Soluble albumen, prepared by the process of Wurtz, has a rotatory power of 30° to 34° to the left. In the white of egg it is accompanied by at least another body, having a higher rotatory power in the same direction. In the white of a hen's egg there are, besides the soluble albumen of Wurtz, two others equally soluble in the same conditions. One is a ferment capable of converting starch into the soluble modification, but without the formation of dextrin or of glucose. It remains soluble in water after having been precipitated by alcohol. The rotatory powers of these three bodies are—

Soluble albumen (Wurtz)	$[\alpha]\ j = 33^\circ$	in water.
,, ,, ,,	$[\alpha]\ j = 32{\cdot}7^\circ$	with the addition of acetic acid.
,, ,, ,,	$[\alpha]\ j = 34{\cdot}4^\circ$	with the addition of carbonate of soda.
Another soluble albumen	$[\alpha]\ j = 53{\cdot}6^\circ$	in water.
Egg zymose	$[\alpha]\ j = 70{\cdot}8^\circ$	in water.

All to the left.

In the yolk there are three matters; the first, an insoluble and probably organised albumenoid, forms the largest part of the vitelline. When freed from all accompanying substances it liquefies starch. The other two albumenoids of the yolk are soluble in water. One of them is rendered insoluble by alcohol, whilst the other remains soluble, and acts as a ferment upon starch, though without saccharifying it. Its rotatory power is 46·5° to the left. The author names it lecithozymose. The albumenoid matters of cow's milk are also mixtures of distinct bodies, having widely different rotatory powers. The casein of new milk, dissolved in carbonate of soda, has a rotatory power of 109·7 to the left. Galactozymose, the ferment of milk, has the power 40·7 also to the left. M. Bechamp is still prosecuting these interesting researches. The methods by which he separates these isomeric albumenoids will be made public on a future occasion.

Action of Water on Sheet-Lead.—M. H. Maraes.—The author considers sulphide of hydrogen as the most sensitive reagent for salts of lead in water. It gives with milk containing 1-10,000th of lead a flesh-red colour. The author does not admit that the presence of calcareous carbonate and sulphate renders water incapable of acting upon lead. Turnings of lead, placed in water containing an excess of the carbonate and bicarbonate of lime, were gradually acted upon, and after standing for twenty days the water was distinctly coloured by sulphide of hydrogen.

Researches on the Hydride of Arsenic.—M. Engel.—It has been long admitted that the deposit formed on treating arsenide of zinc with hydrochloric acid is hydride of arsenic. The author, criticising the experiments of Wiederhold, maintains with Soubeiran that hydride of arsenic is not produced under these circumstances.

Action of Iodine on Uric Acid.—M. F. Wurtz.—When iodine is introduced into uric acid held in suspension in water the iodine disappears, and the uric acid is decomposed, yielding alloxane, hydriodic acid, and probably urea.

Synthesis of Oxalyl-Urea (Parabanic Acid).—M. E. Grimaux.—The author causes oxychloride of phosphorus to react upon oxaluric acid, and obtains parabanic acid. He is attempting to prepare succinyl-urea by the reaction of oxychloride of phosphorus upon succinuric acid.

Formation of Equations of Condition from Observations of the Transit of Venus.—M. Puiseux.—Various observations will be made during the transit; the hour of external and of internal contact, the angular distance of the two centres, the angle made by the line of centres with determinate directions, the projection of the distance between the centres on the celestial meridian passing through the sun's centre, or on the parallel at that point or any other direction; each of which will lead to an equation of condition between the various unknown quantities. The author seeks to facilitate the calculations connected with these equations by determining, in advance, certain numbers which enter into them, or at least constructing tables whence they may be readily deduced.

New Reply to M. Pasteur on the Origin of Beer-Yeast.—M. Trecul.

Theoretical Essay on the Equilibrium of Elasticity of Pulverulent Masses, and on the Thrust of Earths that are without Cohesion.—Extract from memoir by M. Boussinesq.—The equilibrium here studied is that produced in a sand mass which is at rest, and is supported by a wall firm enough not to be liable to shaking.

New Arrangement of the Hydro-Electric Sulphate of Copper Pile (M. Becquerel's).—M. Trouvé.—The salts of copper and zinc are simply maintained in contact with the metals (of same name) by the capillary action in rolls of paper. The pile is very portable, has the same electromotive force as an ordinary sulphate of copper pile of the same number of couples, and may act continuously for a long time if placed in a closed vessel to obviate desiccation.

Certain Relations between the Colouration of Birds and their Geographical Distribution.—M. Alph. Milne-Edwards.—The author remarks that in certain ornithological families (swans and parrots, *e.g.*) the tendency to melanism, or black plumage, only appears in the Southern Hemisphere, and more particularly in the region comprising New Zealand, Papua, Madagascar, and intermediate parts.

Waterspouts and Whirlwinds.—M. Mouchez.—The author recounts some of his own observations. It is very common (he thinks) in using the name *trombe* to confound two meteors that are quite different in causes and effects. One of these, the whirlwind or cyclone, occurs when two neighbouring layers of a moving fluid, accidentally made to deviate, meet at angles, or with different velocities. The molecules in the line of meeting are subjected to a couple, which produces the gyration. The whirlwind may take a second movement of translation in the direction of the component of the two currents giving rise to it. The essential condition of the phenomenon is a wind. Clouds may or may not be present. The *trombe*, on the other hand, always forms at the base of a dense nimbus cloud, and only in dead calm, or with a faint breeze; a moderate wind dissipates it at once. A protuberance descends from the cloud towards the sea, and presently takes the form of a column or tube which remains vertical, or if there is a breeze undulates slightly. When this tube, which is sheathed at the upper part by a more diffuse tube, has reached about ⅓ of the height of the cloud the water surface below begins to boil: then, at a short distance, one may distinctly see a jet of vapour rise from the sea like a vertical sheaf about the base of the *trombe*, if that is vertical, or oblique, and with angle of reflection equal to angle of incidence, if the *trombe* is inclined. While the emission of vapour or of water takes place, the tube gets clearer and clearer, and ends by appearing under the form of two distinct dark lines. When the vapour-jet has ceased the *trombe* seems to have finished its work; for it begins to dissolve at its lower part and to rise again, gradually, to the cloud, in which it is at length lost. This is the general type of the phenomenon, but there are some singular modifications. Sometimes there is a series of two or three concentric tubes, the external ones shorter than the internal. In one case observed, the tube instead of dissolving after cessation of the vapour-jet seemed transformed into a kind of chimney, within which little flocks of vapour could be seen gradually rising towards the cloud, and oscillating from side to side (which may have led to the opinion that the movement in *trombes* is from below upwards). In another case the *trombe* seemed like a tube closed below, or a very long bag. The lower part was rounded and darker than the rest. The sea boiled under it as under open tubes. This is the only case, M. Mouchez thinks, in which electricity might be called in to explain the effects. Once more; there are *trombes* which have their two extremities widened in form of a funnel; the lower mouth seems to enlarge as though under strong pressure, and the water-jet is a diverging one, like that from the rose of a watering-pot. One cloud may produce several *trombes*, some of which are dissipated before full development. A fully formed *trombe* seems to become adherent to the point of the sea which it meets, for its base remains unmoved when the cloud above takes a slight movement of translation; one sees it then becoming more and more inclined, elongated, and then torn asunder before having passed through all its phases. M. Mouchez never observed lightning or thunder accompany *trombes*. Rain rarely precedes, always follows, but never co-exists with the meteor. From measurements he made, the lower diameter seems to have varied between 5 and 20 metres, the upper diameter being twice or thrice as great, the height of the cloud between 200 and 500 metres. The *trombe* lasts from ten to twenty minutes. The chopping of the sea covers a circle four or five times greater than the diameter of the tube. The height of the waves never reaches one metre. None of the *trombes* the author saw would have been at all dangerous to a ship; they would probably have occasioned nothing more than a good bath of water or vapour. There is no violence in the phenomenon. It thus quite differs from that sometimes described as occurring in the middle of a tempest, a huge mass of water being raised, whirlwind-wise, and threatening shipwreck. The author states that he has never seen these tempest *trombes*; which, if real, must have quite different causes from those described. The impression produced by the latter is that of a mass of air, suddenly cooled, descending by its own weight through clouds having a certain force of cohesion. This explanation goes to confirm the view that there is a *descending* movement in *trombes*. In whirlwinds, on the other hand, one sees nearly always an *ascending* movement in the direction of the axis, which results in a longer duration of the meteor. We have here an essential difference between the two phenomena which are so often confounded.

Bulletin de la Societe Chimique de Paris, tome xx., No. 10, November 20, 1873.

On Pentachlorated Benzins.—M. A. Ladenburg.—An addition of some details to the author's former paper on the subject.

Oxalins—a New Class of Ethers of the Polyatomic Alcohols properly so called; New Characteristic of these Alcohols.—M. Lorin.—The author gives the experiments which enabled him to affirm the existence of the oxalins. The property of producing oxamide when heated with oxalic acid and mixed with ammonia may serve to detect and define the chemical function of an alcohol.

Rotatory Power of the Hyposulphates.—M. E. Bichat.—The author supports the view announced by M. Pape that the crystals of the hyposulphates of potassa, lead, strontia, and lime have a rotatory power. Those of hypo-sulphate of potassa belong to the regular hexagonal system.

Solubility of Arsenious Acid in Water.—M. L. A. Buchner.—1 part of crystalline arsenious acid dissolves, after 24 hours digestion, in 355 parts of water at 15° C. The amorphous acid, in the same conditions, requires 108 of water. If the crystalline acid has been dissolved at a boiling heat, and the solution left to stand for twenty-four hours, it contains to 1 part of acid 46 of water. The amorphous acid, in the same circumstances, remains dissolved in 30 parts of water.

Reduction of Carbonic Acid and Carbonic Oxide by Phosphate of Iron.—M. S. H. Horsford.—The author has found that when carbonic acid and a mixture of phosphate of soda and green vitriol with a little water are introduced into a tube, the carbonic acid is gradually reduced to carbonic oxide. The author considers this phenomenon as very important for vegetation.

On Tempering Steel for Tools.—The following procedure, due to M. Kulicke, is in use at the works at Saarbruck. It serves to restore the nature of steel altered or burnt, and consists in plunging the article—previously brought to a cherry-red heat and forged for an instant—into the following mixture, and then into cold water. Tartaric acid, 12 parts; fish-oil, 60 parts; powdered charcoal, 4 parts; bone-black, 16 parts; yellow prussiate, 20 parts; tallow, 20 parts; burnt stag's horn, 6 parts.

Reimann's Farber Zeitung, No. 47, 1873.

This number contains receipts for a light silver-grey and a steel-blue on plush, a bluish drab on wool, an orange and a grain-scarlet on woollen-yarn, a black and a chamois on cotton-wool.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxiii., No. 15, December 11.

Action of Water, and of Certain Solutions of Neutral Salts upon Sugar.—W. L. Clasen.—The author refers to the experiments of Soubeiran, Berthelot, Maumené, and Bechamp, and seeks to verify their results by employing both polarised light and the cupro-potassic liquor. He confirms the disputed view of Maumené—the transmutation of sugar into inverted sugar at common temperatures, and without any notable formation of mould. The author adds that it is not possible to determine glucose by the saccharimeter, as the errors of observation exceed the effect of the glucose produced. The determination can only be made by means of the cupro-potassic tartrate, which other carbo-hydrates have also the power of reducing.

On Turacin.—J. J. Monteiro.—The author fully confirms the results of Church as to the presence of copper in the feathers of the Touraco. Copper exists in the regions inhabited by the bird in the state of green carbonate (malachite).

No. 3, January 15, 1874.

Use of Sulphide of Cadmium for Colouring Soaps.—To detect zinc-white, which is often present as an impurity in the cadmium compound, the suspected sample is digested in acetic acid. On adding carbonate of soda to the solution thus obtained, a white precipitate is formed if zinc be present.

Mordanting with Alum.—According to Havrez the alum used for this purpose should not exceed 1-10th of the weight of the goods to be dyed, or the hydrate of alumina at first deposited on the fibre will be re-dissolved, producing thus flat and meagre shades.

Improvement in the Manufacture of Bread.—E. du Mesnil.—The author, in opposition to Pasteur, ascribes fermentation to the action of oxygen, the formation of a gaseous electric pile, and the decomposition of water, which "furnishes to the saccharine matters, on the one hand, the carbonic element, and, on the other, the element of alcohol.

MISCELLANEOUS.

Chemical Appointment.—The Japanese Government have, through their Legation in London, appointed Mr. R. Routledge, B.Sc., F.C.S., to the Professorship of Chemistry and Physics in the Imperial College at Yeddo. Mr. Routledge studied science at the Owens College, Manchester, where he had Dr. Roscoe for his instructor in chemistry, and took a distinguished place in the Honours Examinations of the University of London in 1869 and 1870.

Report of the Public Analyst for the Strand District.—Mr. C. H. Piesse, the Analyst for the Strand District, laid his report before the Board of Works for that District on the 11th inst. Of 121 samples of various articles of food analysed by him during the past three months, only one (a sample of milk) was adulterated. Much attention had been given to "patent" articles of food, and to substances sold as "mixtures." He pointed out as a result that it was advisable to make the terms of the Adulteration Act quantitative, instead of merely qualitative. Very slight modifications of Clauses 3 and 7 would effect the alteration. Under Clause 3 it should be compulsory for the vendors of "mixtures" to state not only the nature of the admixtures, but also the quantities of them in proportions of 100 parts, and under Clause 7 the Analyst to report quantitatively in addition to the qualitative statement now required; and he proposed that the suggested alterations should be brought before the Government by the Board. The other points were of merely local interest.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the electro-deposition of tin. Thomas Fearn, Birmingham, Warwick, electro-metallurgist. April 7, 1873.—No. 1277. This invention consists of solutions made and used in the manner described for the deposition of tin by electricity. One solution consists of a solution of protochloride of tin, to which are added a solution of hydrate of potash and a solution of cyanide of potassium, and, lastly, a solution of pyrophosphate of soda. Another solution consists of a solution of protochloride of tin, to which are added a solution of pyrophosphate of soda and a solution of muriate of ammonia. Another solution consists of a solution of protochloride of tin, to which a solution of muriate of ammonia is added. Another solution consists of a solution of protochloride of tin, to which are added a solution of tartrate of potash and a solution of hydrate of potash. The proportions of the several solutions which are mixed together are described, also the battery power employed, and the temperature of the solutions.

Improvements in the utilisation of waste products of ammoniacal liquor. Arthur William Ellis, manufacturing chemist, Madeira Villas, Woodford, Essex. April 8, 1873.—No. 1285. The precipitation and collection of cyanogen substances from the hitherto wasted (or spent) liquor produced in the distillation of ammoniacal liquor.

Improvements in the treatment of night-soil, of sewage deposits, and of other similar moist manurial matters. Gustav Alsing, civil engineer, 3, Bank Place, Preston. April 9, 1873.—No. 1319. This invention consists in a method of rapidly fixing or solidifying moist night-soil, sewage, slush, or other similar moist manurial matters, in order to render such material conveniently portable and capable of being inoffensively stored for use as manures, by mixing it with a certain proportion of sulphate of calcium or burnt gypsum, commonly known as plaster of paris. In order to facilitate the mixing process I use special constructed receptacles, which, by means of worms or screws driven by differential speed-pulleys, deliver the material to be mixed in certain proportions, after which they are mixed in a cylinder and discharged in the form of bricks, or other forms, by filling it into suitable troughs, which may be divided into partitions.

Improvements in the manufacture of artificial fuel. David Barker, Northfleet, Kent. April 10, 1873.—No. 1321. This invention consists in combining coal, coke, and other carbonaceous materials, with a mucilage or liquid formed of farina, water, and a solution of sulphate of alumina or chloride of alumina in hydrochloric acid, pitch and carbolic acid being added thereto, the resulting compound being moulded into blocks, and in some cases, as for instance for blast furnace purposes, a process of re-coking is resorted to.

Improvements in the destructive distillation of shale or other oil-yielding minerals, and in apparatus therefor. Norman McFarlane Henderson, manager of the Oakbank Oil-Works, Mid Calder, Mid Lothian, North Britain. April 10, 1873.—No. 1327. In carrying out the invention according to one modification, a series of four vertical retorts are arranged, in a furnace or oven, with their bottom ends at a little distance above a central fire space or grate. The bottom ends of the retorts are provided with doors capable of being closed gas-tight, and immediately below each door there is an inclined valve which in one position separates the bottom of the retort from the central fire-space, whilst it can be turned over outwards to form an incline down which the spent shale may fall into the fire-space. The four retorts are, by preference, to be drawn and re-charged at separate equidistant periods. More or less of the permanent gas formed during the destructive distillation may be led into the fire-space to aid the combustion, as is ordinarily practised with coal fires.

Improved process or treatment and compositions or compounds for the improvement, waterproofing, and preservation from mildew and moths of silk, wool, cotton, furs, leather, paper, and other articles. William Morris, a citizen of the United States of North America, at present residing at No. 80, Caversham Road, Kentish Town, Middlesex. April 12, 1873.—No. 1344. This invention relates to a new process or treatment and compositions for the improvement of manufactures formed of silk, wool, cotton, flax, or hemp; also furs, leather, and paper; by means of which such manufactures are made incapable of capillary attraction, are rendered waterproof, and not liable to mildew, nor to be attacked by moths; their strength and durability are increased, their porosity is unimpaired, and their general quality and appearance are improved; and by the same process wood is rendered impervious to moisture, and incapable of generating mildew, fungi, &c.; and bricks, tiles, and other articles, are made moisture-proof. The process consists of two steps or parts, as follows:—For the first part is used a chemical compound which consists of, say, one part of dry gelatin (isinglass or other), dissolved in, say, four parts of oil, including a small quantity of sulphuric or other acid, and, when these are combined by means of heat, five parts (or thereabout) of an alkaline solution are added, at a specific gravity of about 26° Baumé, the whole being stirred while yet warm, and the result is a chemical combination designated the "preparatory compound." For the second part of the process is used a chemical compound, designated the "perfecting compound," and which is prepared as follows, namely:—In one vessel is prepared a strong solution of one of the alums, for instance, of the sulphate of alumina, with potassa, or with ammonia, or with soda. In another vessel is prepared a solution of the sulphate of zinc, and in a third vessel a solution of the acetate of lead. These solutions are each to be of the same density. When prepared, the two sulphate solutions are mixed in the proportion of about five parts of the first named to one and a half parts of the latter named, and to these are added about five and a half parts of the acetate of lead solution. By the chemical action that ensues sulphate of lead is formed, and when this has subsided the clear liquid is drawn off, and is reduced to the proper density, which is from 1° to 2° Baumé. The materials to be treated are steeped in baths of the above compounds, or in some cases the preparatory compound may be applied by hand. Some kinds of paper need not be submitted to the preparatory compound.

MEETINGS FOR THE WEEK.

Monday, Feb. 23.—Medical, 8.
—— Geographical, 8.30.
—— London Institution, 4.
Tuesday, 24.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
—— Civil Engineers, 8.
—— Anthropological, 8.
Wednesday, 25.—Society of Arts, 8.
—— London Institution, 7.
—— Geological, 8.
Thursday, 26.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation."
—— Royal, 8.30.
—— Philosophical Club, 6.
Friday, 27.—Royal Institution, 8; Weekly Evening Meeting. Mr. Francis Galton, "On Men of Science, their Nature and Nurture," 9.
Saturday, 28.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

TO CORRESPONDENTS.

Erratum.—Vol. xxix., p. 78, line 21 from bottom, for "no consequence" read "of consequence."

W. W. Roberts.—An answer to your question would require a detailed chemical examination of the sample, which does not come within the province of "Answers to Correspondents."

Professor Tennant's Lectures on Rocks and METALLIC MINERALS at King's College are given on Wednesday and Friday mornings from 9 to 10 o'clock, and on Thursday evenings from 8 to 9. The lectures commenced Thursday, January 22nd, and will be continued to Easter.

PRIVATE INSTRUCTION in GEOLOGY and MINERALOGY can be had by Professor Tennant at his residence, 149, Strand, W.C., by those unable to attend public lectures.

THE CHEMICAL NEWS.

Vol. XXIX. No. 744.

ALUM IN BREAD.

The case of the two Harrow bakers who were charged at the Edgware Petty Sessions with selling bread containing alum in the proportion of 40 grains to the 4-lb. loaf presents many points of interest, and offers another striking example of the difficulties which surround the detection of this description of adulteration.

The facts of the case are as follows:—A few weeks ago a certificate signed by Dr. Redwood, Public Analyst for Middlesex, was produced before the magistrates. This certificate sets forth that certain samples of bread sold by these bakers contained 40 grains of alum in 4 lbs. of bread; and on the strength of this certificate the magistrates were asked to inflict the penalty prescribed by the recent Adulteration Act.

On the other hand, the bakers denied the charge of aluming the bread, and applied for an analysis by an independent chemist, and their application was granted. A portion of each of the samples of bread was accordingly sent to Mr. Wanklyn (who holds office as Public Analyst for Buckinghamshire), and on Wednesday, the 18th inst., Mr. Wanklyn's analysis was produced at the Edgware Petty Sessions, and the adjourned hearing of the case proceeded with.

From the report of the case, which is before us, we gather that Dr. Redwood gave evidence that he had certified to the presence of 40 grains of alum in the 4-lb. loaf, because he had obtained 0·2 grain of a white precipitate from 1000 grains of the bread by a well-known process for the detection of alum in bread.

This process is described in Watts's "Dictionary," and is, we believe, known, as Kuhlmann's process.

Dr. Redwood gave evidence that he had burnt up 1000 grains of the bread in a platinum dish, and then treated the ash with a considerable quantity of nitric acid, and evaporated down to complete dryness in a porcelain dish. The residue was then treated with a few drops of acid and water, boiled, and filtered. The filtrate was then neutralised with carbonate of soda, and then mixed with some solution of pure potash, and boiled in a porcelain dish. After filtration the filtrate was then supersaturated with hydrochloric acid, and rendered alkaline with ammonia or carbonate of ammonia, and boiled, when it gave a precipitate which weighed about 0·2 grain. This precipitate Dr. Redwood said was alumina, and calculating on that basis he certified that the 4-lb. loaf contained about 40 grains of alum.

Mr. Wanklyn, on the other hand, had burnt up 1500 grains of the bread at a very low temperature, and had avoided using porcelain dishes, and did not obtain any precipitate. He did not find any alum.

In the course of the trial it was pointed out that the 0·2 grain of white precipitate which Dr. Redwood said he had obtained could not possibly be alumina, but must have been phosphate of alumina, and that accordingly Dr. Redwood's analysis (assuming its correctness) would only show about 20 grains of alum in the 4-loaf, and not about 40 grains, as had been certified. It was also pointed out that the employment of porcelain was a source of danger.

Under these circumstances the magistrates dismissed the cases.

A correspondence between Dr. Redwood and Mr. Wanklyn on these cases has appeared in the *Circle*. We refer our readers to the correspondence; from which we gather that Dr. Redwood maintains that the precipitate he obtained was alumina.

PRELIMINARY NOTICE ON THE

ACTION OF BROMINE ON PROTOCATECHUIC ACID, GALLIC ACID, AND TANNIN.

By J. STENHOUSE, LL.D., F.R.S., &c.

When protocatechuic acid is treated with excess of bromine in the cold, Barth[*] has shown that one equivalent of the hydrogen is replaced by bromine, giving rise to mono-bromo-protocatechuic acid, $C_7H_5BrO_4$. If, however, protocatechuic acid, or bromo-protocatechuic acid, be heated to 100° with excess of bromine, the reaction which takes place is quite different,—hydrobromic acid and carbonic anhydride are evolved, and the tetra-bromo-pyrocatechin, $C_6H_2Br_4O_2$, described by Hlasiwetz,[†] is produced.

As is well known, pyrocatechuic acid, at a high temperature, splits up into pyrocatechin and carbonic anhydride, but this reaction does not take place at 100°. The presence of bromine, however, determines the decomposition of the acid with simultaneous production of the highly brominated tetra-bromo-pyrocatechin. The latter substance, produced in this way, possesses all the properties ascribed to it by Hlasiwetz. It melts at 187°. The best solvent from which to crystallise it is ordinary acetic acid, of density 1·050.

Although the action of bromine alone, on protocatechuic acid, when gently heated with it, does not go farther than the formation of bromo-protocatechuic acid, iodine bromide under similar circumstances causes a more complete decomposition, giving rise to bromo-pyrocatechin.

As gallic acid has the same relation to pyrogallol that protocatechuic acid has to pyrocatechin, it seemed probable that, when treated with bromine at 100°, it might undergo a similar decomposition: on making the experiment this was found to be the case—hydrobromic acid and carbonic anhydride are evolved, and tribromo-pyrogallol is left.

Here also, when gallic acid is gently heated with bromine, a dibromogallic acid,[‡] $C_7H_4Br_2O_5$, is produced, but at 100°, in the presence of excess of bromine, the acid is resolved into carbonic anhydride and pyrogallol, which is simultaneously converted into the bromo-pyrogallol.

When tannin is heated to 100° in a sealed tube, with excess of commercial bromine, large quantities of hydrobromic acid and carbonic anhydride are liberated, and the product, after the removal of the excess of bromine, was found to consist entirely of bromo-pyrogallol. If, however, both the tannin and the bromine be very carefully dried, the reaction is quite different—hydrobromic acid and some carbonic anhydride are evolved, but the product consists of a dark-coloured substance of a totally different appearance from the colourless crystals of the bromo-pyrogallol. I have not yet investigated the nature of the product obtained by the action of dry bromine on dry tannin, but the result strongly confirms Schiff's[‖] view that tannin is merely digallic anhydride.

In the experiment made with undried tannin and commercial bromine, the small amount of water naturally present in these substances was sufficient to convert the tannin into gallic acid, which was then decomposed with formation of bromo-pyrogallol and evolution of carbonic anhydride.

When protocatechuic acid is heated to 100°, with a saturated solution of chlorine in carbon tetrachloride, in sealed tubes, a chlorinated compound is produced crystallising in needles, which may be purified by crystallisation from carbon disulphide. A similar reaction takes place when pyrogallol is treated with a carbon tetrachloride solution of chlorine. These substances I am at present engaged in investigating.

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[*] *Ann. Chem. Pharm.*, cxlii., 246.

[†] *Ibid.*, cxlii., 251.

[‡] Grimaux, *Bull. Soc. Chim.*, [2], vii., 479.

[‖] *Ann. Chem. Pharm.*, clxx., 43.

PRELIMINARY NOTICE ON THE

ACTION OF BROMINE IN THE PRESENCE OF WATER ON BROMO-PYROGALLOL AND ON BROMO-PYROCATECHIN.

By J. STENHOUSE, LL.D., F.R.S. &c.

Although dry bromine has no action on dry bromo-pyrogallol, even when heated with it for a long time at 100°, yet if water be present a reaction takes place, the nature of which varies with the proportion of bromine and of water employed.

When bromo-pyrogallol is added to about twice its weight of bromine, and then 5 to 10 parts of water are poured on the mixture, there is a slight development of heat, and both the bromine and the bromo-pyrogallol dissolve, forming a deep orange-coloured solution. If this be now gently heated to about 70° or 80° C. it commences to effervesce from the evolution of carbonic anhydride, and in a few minutes bright yellow crystalline plates begin to form, which increase in number until, after the lapse of about ten minutes, the reaction may he considered as terminated. It is not absolutely necessary to heat the solution to obtain this result, as the same compound is produced on allowing the liquid to stand for some days at the ordinary temperature.

This new compound has a composition which may be represented by the empirical formula, $C_9Br_7H_2O_3$, the reaction which takes place being the following:—

$$2C_6H_3Br_3O_3 + 11Br + 3H_2O = C_9H_2Br_7O_3 + 3CO_2 + 10HBr.$$

A determination of the amount of hydrobromic acid produced in this reaction corresponded pretty closely with that required by the above equation. In this experiment if the amount of water be largely increased—to 20 parts or more—the yellow substance is still formed, but in smaller quantity, and is, at the same time, accompanied by an oily matter.

The crude compound may be conveniently purified by recrystallisation, first from carbon disulphide, and then from light petroleum. It forms brilliant yellow plates, which melt at 122° C., and are very soluble in ether, carbon disulphide, and benzene, less so in petroleum. They are soluble in alcohol, but decomposition takes place at the same time, with formation of a colourless crystalline compound.

If, instead of treating the bromo-pyrogallol with twice its weight of bromine, only 1 part be added, and then 5 to 10 of water, the whole dissolves as before, yielding an orange-coloured solution; on allowing this to stand, however, for a short time at the ordinary temperature, colourless scales begin to separate, and gradually increase in amount until the mixture, if sufficiently concentrated, becomes semi-solid. This new substance is colourless, and decomposes when gently heated. It is somewhat soluble in water, but does not appear to be converted into the yellow compound when treated with excess of bromine.

Bromo-pyrocatechin, when heated in a water-bath for about ten minutes with 3 parts of bromine and 10 of water, undergoes a change analogous to that which takes place with pyrogallol. The compound produced in this instance consists of dark crimson-coloured plates, which may be purified by alternate crystallisations from carbon disulphide and carbon tetrachloride. It melts at about 139° C., but appears to undergo decomposition at the same time. It is also decomposed by boiling with petroleum.

From some preliminary experiments I have made with the compounds described in this notice, it seems probable that they will yield many interesting derivatives, an account of which I hope soon to be able to publish.

Combination of Monochloro-Aldehyd with Benzol.—M. E. Hopp treated a mixture of bichlor-ether and benzol with sulphuric acid, and obtained an oily substance which he believes to consist chiefly of the compound in question.

NOTE ON THE SYNTHESIS OF FORMIC ALDEHYD.*

By Sir B. C. BRODIE, Bart., F.R.S.

In a former note I communicated to the Society the result of an experiment in which a mixture of equal (or nearly equal) volumes of hydrogen or carbonic oxide had been submitted, in the induction-tube, to the electric action. My expectation in making the experiment had been that the synthesis of formic aldehyd would be thus effected according to the equation $CO + H_2 = COH_2$. The only permanent gas, however, other than the gases originally present in the induction-tube, which appeared in the result of the experiment was marsh-gas. When a mixture of hydrogen and carbonic acid gas were similarly operated upon, the same hydrocarbon, together with carbonic oxide, was formed. I have now, however, succeeded, by a modification in the conditions of the latter experiment, in attaining the object which I originally had in view. Evidence of this is afforded by the following analysis:—The gas analysed was the result of submitting to the electric action equal volumes of hydrogen and carbonic acid. After removal from the gas of carbonic acid and carbonic oxide, and also of a trace of oxygen, 191·2 volumes of gas remained, in which were found at the conclusion of the analysis 2·6 volumes of nitrogen. Deducting this amount of nitrogen, 188·6 volumes of gas remain, containing the residual hydrogen in the gas, together with any gases besides carbonic oxide formed in the experiment. This gas was analysed by the addition of oxygen and subsequent detonation by the electric spark, the absorption of the carbonic acid by potash, and the removal of the oxygen over by pyrogallate of potash. The results of the analysis entirely concur with the assumption that the 188·6 volumes of gas were constituted of hydrogen, marsh-gas, and formic aldehyd in the proportions given below:—

Hydrogen	183·2
Marsh-gas	0·2
Formic aldehyd	5·2
	188·6

The composition of 100 volumes of the gas being—

Hydrogen	97·14
Marsh-gas	0·10
Formic aldehyd	2·76
	100·00

Another experiment was attended with similar results, only that the proportion of marsh-gas was somewhat greater.

The result of this experiment may be considered to be given in the equation $CO_2 + 2H_2 = COH_2 + H_2O$. I have reason to believe that formic aldehyd is also formed in the reaction of hydrogen and carbonic oxide; and that the marsh-gas found (in both experiments) results from the decomposition of this substance, possibly according to the equation $2COH_2 = CO_2 + CH_4$. I do not now dwell upon this subject, as it is my intention very speedily to lay before the Society, together with other matters, the details of the various experiments which I have made in reference to it.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.†

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 86).

Preparation of Chemically-Pure Thallium.

a. Commercial sulphate of thallium is dissolved in water, and the cold solution deluged with sulphuretted hydrogen. It is then filtered, heated to ebullition, and poured into boiling dilute hydrochloric acid. The solution is filtered whilst hot, and then allowed to cool. The chloride of thallium which crystallises out on cooling is washed by decantation until the washings are free from sulphuric acid, and further purified by re-crystallising twice from water. The chloride of thallium thus obtained is dried, mixed with pure carbonate of sodium, and projected by small portions at a time into pure cyanide of potassium kept in a state of fusion in a white unglazed crucible. The chloride is rapidly reduced to the metallic state; the crucible is then allowed to cool, and the contents exhausted with water. The resulting ingot of metal is well boiled in water, dried and fused over a spirit-lamp* in an unglazed porcelain crucible with free access of air, stirred with a porcelain rod to facilitate oxidation, and finally cast in a porcelain mould. It may be preserved under water which has been boiled to expel the air. This metal was used in the determinations A and B.

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* A Paper read before the Royal Society.

† A Paper read before the Royal Society June 20, 1872.

b. Ordinary metallic thallium is fused in contact with the air, in an iron crucible made nearly red-hot, and then poured into water. The granulated metal is then exposed to a warm atmosphere to facilitate oxidation, the oxide being frequently removed by boiling out with water. When a considerable quantity of oxide (mixed with carbonate) has been obtained, the solution is heated to ebullition, and a rapid current of carbonic acid gas passed through until the liquid is quite cold, and the excess of carbonate of thallium has crystallised out. The resulting salt is re-crystallised and projected into pure cyanide of potassium kept in a state of fusion in a porcelain crucible at a dull red heat; carbonic acid escapes with effervescence, and the metal is reduced to the metallic state. The whole is then allowed to cool, the soluble salts boiled out with water, and the lump of thallium fused over an alcohol-lamp in a lime crucible, and cast in a lime mould as described further on. With this ingot of thallium, the determination C was effected.

c. Carbonate of thallium, obtained as in process *b*, is covered with a small quantity of water, and decomposed by the current from six Grove's cells. Much peroxide of thallium is deposited, which is removed† and preserved for the preparation of thallium by another method. The reduced thallium is then squeezed into a hard cake, melted in a lime crucible heated by means of a spirit-lamp, and cast in a lime mould. This metal was employed in the determination D.

d. A third portion of carbonate of thallium, obtained as in process *b*, is crystallised several times from water, carbonic acid being passed through during the cooling of the solution. After six crystallisations the carbonate is perfectly white. It is then placed in a porcelain dish, covered with a little water, and decomposed by four Grove's cells. The spongy metal is washed, boiled in pure water, tied up in a linen cloth, and compressed between steel plates in a vice. The hard lump is broken up, put into a porcelain crucible, and melted over a spirit-lamp, no flux being used other than the thallium oxide formed on heating. The metal is constantly stirred with a piece of unglazed porcelain, and cast in a warm porcelain mould. With thallium prepared in this manner the synthetical operations E and F were performed.

e. The peroxide of thallium obtained by the electrolysis of the carbonate (processes *c* and *d*) is dissolved in purified sulphuric acid, evaporated to dryness, and heated strongly to decompose any sulphate of peroxide; it is then dissolved in water, and re-crystallised twice. The sulphate of thallium is then reduced to the metallic state by three of Grove's cells, platinum terminals being employed. The metal is squeezed into a lump, and melted under hydrogen in a porcelain crucible, and cast in a polished steel mould, the heat in this case being produced by the combustion of pure hydrogen gas. The thallium purified as above was used in the operation G.

f. Chloride of thallium, as obtained by method *a*, is boiled in nitric acid till most of it is converted into sesquichloride. This is washed by decantation until it begins to decompose with separation of peroxide of thallium, and purified by twice re-crystallising. The purified sesquichloride of thallium is dissolved in boiling water and poured into dilute ammonia. The precipitated peroxide of thallium is washed by decantation till chlorine is no longer detected in the washings, and then boiled in a little water with pure sublimed oxalic acid till the whole is converted into oxalate of thallium. This is dried and heated in a crucible until the whole is decomposed into a mixture of metallic thallium and oxide of thallium; the reduced metal is then cast in a mould of polished steel. The ingot was employed in the determination H.

g. Ordinary thallium is dissolved in nitric acid, and the excess of acid driven off by heat, the residue is dissolved in water, and the solution saturated with sulphuretted hydrogen. A slight black precipitate is generally formed, the solution is filtered cold, and is then freed from sulphuretted hydrogen by boiling. Ammonia is then added, which generally produces a faint precipitate of sesquioxide of iron and peroxide of thallium; it is then filtered, and the solution is mixed with oxalate of ammonium, and concentrated till the oxalate of thallium crystallises out. This is freed from nitrate of ammonium by re-crystallising, and the oxalate of thallium decomposed by heat, as in process *f*. The thallium thus obtained is again fused in a lime crucible, a blowpipe-flame being directed downwards on to the surface of the fused metal for about five minutes, till the slag of thallium oxide has united with the lime, forming a semi-fluid pasty mass. The metal is then cast in a lime mould, washed when cold, and kept under boiled distilled water or very dilute acetic acid. With metal purified in this manner the estimations I and K were performed.

Purification of Thallium by Fusion in Lime.

A piece of well-burnt, very dense quick-lime, prepared from black marble, is cut out so as just to fit a porcelain crucible; a hole is then turned in the centre of the lime, and a lump of lime cut into the form of a stopper. This apparatus is then raised to a temperature above the melting-point of thallium over a spirit-lamp, and the cavity in the lime is gradually filled with the metal, previously purified by one of the above processes, which is introduced in lumps. The stopper is then put on, and the heat raised to dull redness and kept so for half an hour; after which the melted metal is poured into a lime mould, and preserved in a well-stoppered bottle under boiled water or very dilute acetic acid.

The ingots of thallium purified by the various methods above described were kept separate, and were employed in the synthetical operations described further on.

(To be continued.)

EXHIBITION OF APPLIANCES FOR THE PRODUCTION AND ECONOMICAL USE OF FUEL,

IN CONNECTION WITH THE

SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY, MANCHESTER.

(Concluded from page 89).

There is a very good show of various kinds of peat and patent fuel, with the necessary apparatus for condensing and purifying peat.

Kidd's process for carbonising peat consists of a large chamber or drying-room connected with a boiler which supplies superheated steam; from the boiler a steam-pipe passes through the furnace, and from thence into the flue; the steam, in its passage over the boiler-fire, becomes

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[*] A spirit-flame is preferable to one of coal-gas, as the latter contains sulphur.

[†] The operation requires this peroxide of thallium to be constantly removed from the positive pole, or the passage of the current will be retarded and ultimately stopped.

super-heated, and, together with the smoke, passes into the drying-chamber; the peat, cut into pieces about the size of bricks, is put into a framework which runs upon wheels, so that it easily runs into the drying chamber, and is run out again when finished, thus saving a great deal of labour. The object of Kidd's process is the collection of the heated gases referred to in a closed chamber, where they may be usefully employed in charring peat, or converting it into charcoal; an artificial draught is created by jets of superheated steam, and the whole products of combustion from the furnace are forced into and retained by the closed chamber. The chamber is filled with peat, which may be dried and charred in less than forty-eight hours by the action of the furnace gases and superheated steam; the temperature of the chamber soon rises to between 300° and 400° F., and remains at some temperature between those limits. By charring the peat at a low temperature the loss of hydrocarbons is very small, the gases which are poured into the chamber being for the most part non-supporters of combustion; consequently it is impossible for the peat to take fire during the process of charring. The fuel used in the furnace which supplies the gases and generates the steam is peat, which has been partially dried in the open air. It is estimated that a ton of peat charcoal can be produced by this method at a cost of 13s. 6d., which sum includes all charges for interest on capital, royalties, and labour; raw peat at 3s. a ton; that used for fuel, 4s. 6d. per ton. Peat thus prepared produces a gas of high illuminating power, ranging between 20 and 22 candles, and 6000 and 9000 feet per ton; the gas is generated so quickly that three charges of peat can be worked off to one of coal, thus effecting considerable economy in the plant of gas works. The charcoal which remains after the gas has been extracted is also much more valuable than the ordinary coal-gas coke. There is, no doubt, a large field open for commercial enterprise in the manufacture of peat charcoal, owing to its freedom from sulphur and its affinity for oxygen at a high temperature. It is equal to ordinary charcoal for refining iron, steel, and other metals. In France, this charcoal, under the name of *carbon roux*, is largely used in the manufacture of gunpowder; it has been used as a fertiliser also for filtering water and town sewage, and when combined with a proper admixture of phosphate of lime it has been found useful as a substitute for animal charcoal.

Henry Clayton and Son show some fine machinery for preparing and forming blocks of condensed peat. One of the difficulties in preparing peat for the market is to get rid of the large amount of water which it contains, as sometimes it is met with containing from 55 to 80 per cent. Of this, a variable proportion is "loose, or free water," much of which, when present in the larger quantity, can be extracted by means of drainage and squeezing; the great bulk, however, of the water is "locked up," confined in the rooty, or fibrous portion of the peat. So retentive is peat of this fixed water, that no pressure, however powerful, can effect its expulsion while the peat remains in its natural condition. The objects which the Messrs. Clayton aim at are:—To get rid of as much water as possible by draining and squeezing, then to thoroughly cut up the fibrous or rooty portion, releasing the great quantity of water and air which was previously fast in the fibre, and reducing the whole to an uniform state of pulp. Peat thus prepared will freely and rapidly part with its moisture by natural evaporation, and in so doing will consolidate itself, and thus acquire a density which no pressure of the peat in its natural state could produce, becoming very hard and compact, and of a specific gravity nearly equal to coal; in this state it is (unlike the common prepared turfs) non-absorbent of water. The patentees of the condensed peat say that it produces little or no smoke, contains no sulphur, ignites more readily, and diffuses the heat more generally and more widely, than coal itself; leaves no cinder and but little ash. To accomplish these objects with peat direct from the bog, the peat is filled (as dug) into squeezing-trucks, and during its conveyance from the bog to the machine much of the "free water" is pressed from the raw peat by a simple and easy means. From the trucks the peat is discharged into the machine, which, in its action, continuously cuts up minutely the fibrous portions of the peat, and produces a perfect admixture of the cut up fibre and rooty matter with the pulpous portion, thereby utilising the whole mass of the bog and entirely destroying its original character and natural spongy nature. In its travel through the machine the material further undergoes a moderate amount of pressure, and acquires a density and form permitting it to be discharged and deposited upon portable trays in blocks or briquettes of convenient size, and thence conveyed by a simple and labour-saving contrivance to the drying-sheds, where, after three weeks' drying (during average weather), the prepared peat becomes hard, compact, marketable fuel. A trial of condensed peat was made some time since for railway engines on the Belfast and Northern Counties Railway, with a view of testing its qualities as a fuel for locomotives. The engineers who made the trial say: "In order carefully to watch the power of the fuel in the generation of steam, we rode on the engine from Carrick Junction to Ballymena, a distance of twenty-seven miles. The pressure at starting was 100 lbs. on the square inch; the commencement of the journey was up an incline of about 1 in 80, 4 miles long, and with double curves. While going up the incline the pressure rose to 110 lbs., and afterwards to 120; the speed, whenever this was permitted, was 40 miles per hour."

Particulars of the above Locomotive Trial of Condensed Peat Fuel.

Total quantity of fuel used	14 cwts. 1 qr. 14 lbs.
Weight of train, including engine and tender	70 tons.
Number of carriages	Seven.
Miles run	74.
Time running	3 hrs. 9 mins.
Weight per mile used of peat fuel	21·47 lbs.
Average pounds per mile for the last three months, using Welsh and Scotch coals at a ratio of 2 of Welsh to 1 of Scotch	25·25 lbs.
Average for the month of May last	26·29 lbs.

The engineers conclude their report by saying:—"Having carefully noted all these facts, we have no hesitation in saying that we consider the condensed peat in every way well adapted as fuel for locomotive purposes."

A series of experiments have been made at the Commercial Gas Works, London, on condensed peat, the results of which are given below:—

Yield of One Ton of Coal.

Description of Coal.	Cubic feet of Gas.	Illuminating power in Sperm Candles.	Cwts. of Coke.	Gas per ton, equal to lbs. of Sperm.	Sperm corresponding to Gas of Boghead Cannel No. 2, equals 100.
Staffordshire	7,100	12·42	12·5	302	13·6
Derbyshire	7,600	11·71	17	305	13·7
Lochgelly	8,000	18·00	13	494	22·2
Derbyshire Cannel ..	8,500	20·60	15	600	27·0
Wigan Cannel	10,000	20·00	13·25	686	30·9
Newcastle Cannel ..	9,800	25·00	13·25	840	37·8
Lesmahago Cannel	10,500	40·00	10	1,440	64·8
Boghead (No. 1) ..	12,500	40·00	8	1,713	77·1
" (No. 2) ..	13,000	48·00	6	2,222	100·0

Yield of One Ton of Condensed Peat.

Belfast	10,500	15·65	8	562	25·3
Creavelea	9,240	18·75	8·75	594	26·7
Welsh	11,000	22·50	7	849	38·2

The following, extracted from a tabulated statement giving details of the various peat enterprises actually now working, will afford some interesting information on peat manufacture:—

System.	Where Working.	Horse-Power.	Tons of Dry Fuel per Machine per Season.	Cost per Ton.	Relative Value of to Coal.
Hodge's Canadian Peat Company.	Montreal, for Grand Trunk Railway.	16	4000	6s. 6d.	5-6ths, or 84 p. ct.
Boston Peat Company.	New England States.	12	4200	8s.	84 p. ct.
Roberts, Pekin.	New York.	13	3500	8s. to 9s.	84 p. ct.
Haspalmoor. Colbermoor.	Bavarian Government Works.	Not stated.	Not stated.	12s.	60 p. ct.
Box's.	On trial.	16	Not stated.	Stated 4s. 8d.	—
Clayton and Son.	Gt. Britain and Germany.	6	3500	3s. 6d. to 5s.	Variable according to quality of peat.

From the foregoing it will be seen that peat fuel possesses a calorific power of five-sixths of coal, and can be produced in Canada and the United States at from 6s. 6d. to 9s. per ton, where wages for labour are not lower than 7s. per day.

The Peat Coal and Charcoal Company make a show of peat in all its stages, from the time it is taken from the bog to the time it is compressed and carved, for they have some pieces which have been cut into flowers and fruit, till it looks like carved ebony. This Company has bought the patent rights of M. Challeton de Brughat; his process consists in making peat coal having nearly the same density as pit coal, and also he claims to have invented a better method of preparing peat charcoal. The cost of this peat coal at the manufactories may be taken at 8s. per ton for small quantities, and 6s. to 6s. 6d. for large quantities. 1¼ tons of peat coal made by this process is reckoned to be equal to 1 ton of best English coal; for stowage it will only take, on an average, 20 per cent more room than ordinary coal. This Company intend to establish their first manufactory on the borders of North Wales and Shropshire. The peat on this land is of the best quality, averaging in depth about 12 feet. A trial of this peat was made on the Thames, on board the paddle-steamer *Times*, in the presence of the Duke of Sutherland and a distinguished company. The steamer ran from Beckton gas works to Greenwich in twenty-five minutes with a strong head wind, slack water at top of tide; and the quantity of uncompressed peat fuel consumed in this twenty-five minutes' run was about 210 lbs., maintaining a steady steam pressure of 50 lbs. without smoke, and at all times a good clear fire. The experimenters state that for the generation of steam it requires but a very moderate current of air, is absolutely smokeless, and gets up steam equally quick as coal, and maintains it with a less expenditure of fuel, does not injure the fire-bars, and is in every respect much cleaner than coal or coke.

The South of Scotland Peat Fuel Company exhibit fine samples of peat, which have been analysed and reported upon by Mr. Heddle, Professor of Chemistry in the University of St. Andrews.

The composition of the dried fuel, on analysis by combustion, is—

Gas	60·293
Carbon, free	31·064
Ash	8·643

In its ordinary condition, however, it contains—

Water	16·740
Gas	50·200
Carbon	25·864
Ash	7·196

It was found that a sample kept for some days under cover contained 16·4 per cent of moisture, and that samples artificially dried regained upon exposure nearly the above amount, so that it may be held to be impracticable to improve the fuel in this respect: the fuel yields gas at the rate of 7984 cubic feet per ton. When examined by Lewis Thompson's fuel test-apparatus, the calorific power of the fuel was found to be—

In its usual state ..	4·675
When dried	5·940

That is, one part of the fuel will boil off as steam above 4½ times its own weight of water from 212°, and the dry fuel about 6 times its own weight.

A. C. Pelly shows his patent peat fuel, which he condenses into solid balls, of the density of hard wood: the peat balls, when manufactured ready for use, cost only about 5s. 6d. to 6s. per ton.

Prof. Reynolds reports upon the process, which consists in pulping the raw peat in a horizontal cylinder, within which a shaft carrying a number of arms is made to rotate rapidly, by steam or other power. The fibre is not only broken in this machine, but, owing to a screw-like action of the shaft, the peat pulp is forced through a circular opening, and then appears as a cylinder of pasty material, which is cut into short sections by very simple apparatus: the short cylinders of pulp so obtained fall immediately into a truncated cone, revolving rapidly. Here each piece is made to assume a rough spherical form: these pieces are then dried. The dry product of these simple operations appears in the form of irregular balls; hence the term ball-peat. The following is Prof. Reynolds's analysis of two samples of ball-peat:—

Hydrostatic moisture..	15·12	14·87
Carbon	46·95	47·22
Hydrogen	5·01	5·14
Oxygen	29·83	31·22
Nitrogen..	0·38	0·74
Ash	2·71	0·81

Professor Reynolds says—It is well known that the heating effect practically obtained from ordinary rough turf rarely exceeds 40 per cent of that afforded by Staffordshire coal: this ball-peat possesses a heating value equivalent to 55 per cent of that of the class of coal mentioned, or, in other words, to produce the heating effect obtainable from 1 ton of average Staffordshire coal it is necessary to burn about 2½ tons of ordinary turf, while 1¾ tons of ball-peat would give the same amount of heat.

Reuben and Israel Levy exhibit "Leigh's" Patent Phœnix Fuel, which consists of refuse from coal fires mixed with tar or pitch, and made into balls. We cannot see the economy of the process, as it leaves 75 per cent of ash: they claim the novelty of using the ashes *ad infinitum*.

Radeke's patent artificial fuel consists of small coal, bound together in blocks by the aid of silica, both in solution and in a powdered state.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 19, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Mr. Walter Hills was formally admitted as a Fellow of the Society.

The names read for the first time were those of Messrs. Edward Townley Hardman, Leslie Crassweller Hill, Thomas W. Shore, William Kellner, and Andrew Fuller Hargreaves.

For the third time—Messrs. John George Lyon, Francis J. W. Polglase, Magnus Ohren, Harry Grimshaw, William Carleton Williams, Herbert Green, Henry Tanner, Colonel William Boyle, Thomas Carnelly, B.Sc., and Alexander H. Sexton, who were then ballotted for and duly elected.

The President then called on Mr. J. Bell, of the Laboratory, Somerset House, to deliver his lecture on

"*The Detection of Adulteration in Articles of Food and Drink.*"

The lecturer commenced by some preliminary remarks on the fiscal regulations with regard to adulteration. As early as 1777, an Act of Parliament was passed to prevent the adulteration of tea, and in the following year another directed against the adulteration of tea and coffee. In the prosecutions instituted by the excise, however, every facility is afforded to the accused to defend himself, by allowing him to have portions of the same sample as that analysed at Somerset House for analysis and examination by his own chemist, and in all cases taken into court the analyst has to give his evidence on oath, and the defendant is finally dealt with according to the circumstances of the case.

As the cheapness of many of the starches causes them to be largely used for adulteration, one of the first things necessary in studying the subject is to become acquainted with the microscopic characters of the various starches, such as those of wheat, barley, oats, rye, maize, sago, rice, potatoes, beans, peas, &c. The speaker pointed out the distinctive characters of these, illustrating his description by well executed drawings of the appearance which the different varieties of granules present under the microscope. He also noticed the various kinds of arrowroot occurring in commerce, namely—that of the *Maranta arundinaceæ*; the East Indian or Curcuma arrowroot, from *Curcuma angustifolia*; the Tacca arrowroot, from *Tacca oceanica*; Cassava or Tapioca, from *Manihot utilissima*; the Portland arrowroot, from the tubers of *Arum maculatum*; and the Canna or Tous-les-Mois, from the *Canna edulis*.

The next subject treated was the adulteration of coffee, which can only be successfully accomplished after it is roasted and ground, but has, perhaps, been carried to as great an extent as almost any other article of food. A very simple way of detecting the presence of chicory in coffee is to sprinkle a little of it on the surface of water in a test-tube or wine-glass, when each particle of chicory becomes surrounded with an amber-coloured cloud, which spreads in streaks through the water until the whole acquires a brownish tinge; with pure coffee, however, no cloud is produced until the lapse of about a quarter of an hour. Another method of detecting adulteration is by the depth of colour obtained by the infusion of a given weight of the suspected article in water, and by the density of the infusion. The use of the microscope is, however, indispensable, and for this purpose it is necessary to be acquainted with the microscopic characters of the various substances used to adulterate the coffee, such as chicory, mangold wurzel, carrots, parsnips, turnips, beans, peas, acorns, locust-beans, rye, the husks of mustard-seeds, &c. The distinctive characters of these were described by the lecturer, and illustrated by enlarged drawings. He also noticed that the ash of coffee, remarkable as it is for the minute quantity of silica it contains, and for the absence of soda, afforded a valuable indication of its purity.

Tea is adulterated to a very large extent, not only with leaves of various kinds, including exhausted tea-leaves, but also with inorganic substances, such as quartz, sand, and magnetic oxide of iron; these latter substances are rolled up inside the leaf, and one sample of green tea examined was found to contain no less than 20 per cent of quartz and 8·6 of the magnetic oxide. The latter may readily be separated by grinding up the tea, and removing the magnetic oxide with a magnet. The facing employed for green tea usually consists of French chalk and Prussian blue. In the preparation of exhausted tea-leaves, they are rolled up with gum-water, and then dried, catechu being added in some cases to restore the astringency. The article known as the "maloo mixture" consists essentially of exhausted tea-leaves. In searching for the presence of other leaves than those of the tea-plant, the best method is to heat a small quantity of the suspected tea with water until the leaves are sufficiently softened to admit of being unfolded. They should then be spread out on a piece of glass, and carefully examined as to the nature of the serratures and the character of the venation, also the form of the cells of the epidermis and the stomata, and the peculiarities of the hairs as shown by the microscope. The essential differences which the tea-leaf presents when compared with other leaves were minutely described. The chemical composition of tea was next discussed, the amount of lignin and of tannin being very important.

The two kinds of pepper, known in commerce as black and white pepper, are derived from the same plant, but differ in the latter being bleached, or having the husk removed by washing; but neither kind can be adulterated with success before it is ground. The most common adulterants of ground pepper are linseed-meal, the husks of mustard-seeds, rice, bean- and pea-meal, and the flour and bran of the ordinary cereals, ground chilies being sometimes added to restore the pungency. Some of these substances can be readily detected by diffusing the pepper in water, and pouring the mixture on to a muslin sieve; the deep red particles of the chili can then be recognised, and also the camphor-like fragments of rice. The mustard-husks are known by their cup-like shape, whilst the smooth shining appearance of the linseed readily distinguishes it from the dull brown of the pepper.

The lecture was copiously illustrated by drawings of the structures of the various substances treated of, as exhibited under the microscope; but, from want of time, the lecturer was unable to say anything about the adulteration of cocoa, tobacco, or beer.

Dr. Odling, in proposing a vote of thanks to the lecturer, said how greatly obliged they were to him for his discourse, illustrated as it was with so many admirable drawings of the microscopic structure of the various articles of food and of the substances used to adulterate them. It was a great privilege to be allowed to draw from the large store of valuable information he had accumulated, and hoped that it might be put in some permanent form for reference.

The lecturer, in replying to questions from Dr. Wright and Dr. Voelcker, said that the amount of ligneous matter in tea was determined by thoroughly exhausting the leaves by repeatedly boiling them with fresh quantities of water until the washings were colourless. He thought that the amount of theine in tea did not afford positive evidence as to whether it was adulterated or not, as the amount in the different qualities of tea varied from 1·8 to 5·9 per cent; the estimation of the tannin present was far more important.

The meeting finally adjourned until Thursday, March 5, when papers will be read—(1) "On the Condition of the Spontaneous Inflammability of Charcoal," by Mr. G. F. Hargreaves. (2) "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part IV., On the Bromides of the Olefines," by Dr. J. H. Gladstone and Mr. A. Tribe. (3) "Action of Benzyl Chloride on Camphor; Part II.," by Dr. Donato Tommasi. (4) "Action of Trichloracetyl Chloride on Urea," by Messrs. D. Tommasi and R. Meldola. (5) "On Sulphocyanide of Ammonium and Sulphocyanogen," by Dr. T. L. Phipson. (6) "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part V., On Ethyl Bromide," by Dr. J. H. Gladstone and Mr. A. Tribe. (7) "On the Action of Hydrogen on Finely-Divided Metals, by Mr. A. Tribe.

Erratum.—In our report of the meeting of the Society on Feb. 5 (see p. 81), Dr. Odling's remarks on Dr. How's paper, that "the results were not new," *only* applies to "the varying amount of coke yielded by the coal in experiments on small quantities."

Society of Arts.—At the first meeting of the Chemical Section of this Society, Mr. Frederick Field, F.R.S., will read a paper "On the Paraffin Industry." Dr. Odling, F.R.S., will preside, and, as this is the opening meeting of the Section, he has undertaken to give a short address upon "The Importance of Industrial Chemistry."

CORRESPONDENCE.

DETECTION AND ESTIMATION OF ALUM IN FLOUR AND BREAD.

To the Editor of the Chemical News.

Sir,—Through the medium of your valuable paper I shall be glad to offer a few remarks on the above subject, with special reference to a method devised and recommended by Mr. Wanklyn. Suffice it for me to mention here that it is an incineration process aided by oxygen, employing not less than 150 or 200 grms. of bread. I say so far so good, and, indeed, further, for I think that all analytical chemists will agree that the use of the smallest *adequate* quantities of reagents is always preferable and safest in all analytical operations, especially of a quantitative character, which is what Mr. Wanklyn aims at by the method referred to, in recommending a certain measured quantity of hydric sulphate and weighed quantities of the other chemicals required. So that the soundness of the principle involved is beyond dispute; and, indeed, when I first perused the instructions I looked upon the whole process with much favour, but upon further consideration in its application to bread (not flour) I conceived a weak point, which experiments purposely directed have proved to be so. We are all aware that bread contains some sodic chloride, which of course is left with the ash, so that when the residue is treated with concentrated hydric sulphate, as recommended, copious fumes of hydric chloride are evolved; heat has now to be applied till sulphuric fumes begin to rise. Thus I imagined some aluminic chloride may escape, and my experiments with alumised bread (2 grms. alum to the 4-lb. loaf) have clearly proved it to be so; for I have been unable to get the slightest indication of alumina in the several experiments I have conducted according to Mr. Wanklyn's method, except that rather more of the reagents than recommended were found requisite; the residue from the same bread has yielded alumina by treatment with hydric chloride, &c., in all of the several cases tried.—I am, &c.,

E. W. T. Jones, F.C.S.
County and Borough Analyst.

10, Victoria St., Wolverhampton,
February 18, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 5, 1874.

Conductibility of Magnetic Tensions.—M. Jamin.—The expression *coercitive force* has been used to denote the difficulty of magnetising iron or steel, and the resistance opposed to the causes of demagnetisation. This is somewhat vague M. Jamin says. Suppose an iron bar brought near to, say, the austral end of an electro-magnetised bar. The former takes boreal magnetism at its nearest end, austral at its furthest. There is a mean line always between the middle and the core. It nears this core as the bar nears it, and finally disappears when the bar comes into contact with the core. Then the boreal tension is wholly concentrated at the face of contact, concealed by an equal magnetism accumulated in the core. There remains only austral tension prolonged from the core to all points of the bar. Here note two essential things:—1. The tension is always the same on the two sides of the face of contact; on one hand in the core, on the other in the bar; there is magnetic equilibrium without a difference, a fall between the two metals. 2. The austral tension continues along the bar to its free end almost without diminution of intensity, if the bar do not exceed 85 centimetres. Thus soft iron has the double property of becoming in equilibrium of tension with a magnet which it touches, and of propagating this tension through its substance to great distances. This is its essential character, which may be expressed by saying that it is a *good conductor of magnetic tensions*. Steel, again, has a small conductivity for magnetic tensions.

Mechanical Interpretation of the Laws of Dulong and Petit, and of Woestyn on Atomic Specific Heats (apropos of Recent Observations by MM. Lockyer, Dumas, and Berthelot).—M. Ledieu.—The author concludes—(1). That, according to Dulong and Petit's law (corrected), the mean vibratory *vis viva* of the atoms in absolute simple bodies, with a given temperature, is the same; and, *vice versa*, the law follows from this equality. (2). The hypothesis of constancy of said force, whether the atoms form part of a simple or compound body, has, for direct corollary, Woestyn's law (corrected). (3). Add the supposition that the bodies hitherto thought simple may be decomposable into other primary elements under very high temperatures, and we have an interesting interpretation of the equality of absolute atomic specific heats of substances hitherto thought simple, viz., the molecules of these substances, representing their actual atom, may be composed of an equal number of primary atoms having the same mass or not.

Ascent of the Balloon "Jules Favre" in Southern Russia.—M. de Fonvielle.—M. Bunella went up in this balloon from Karkoff on Nov. 2, at 3.30 p.m., and the voyage lasted till midnight; during which the balloon was carried only 190 kils. in horizontal direction, and reached a maximum height of 2700 metres; this after sunset. The motion of the air was more rapid near the ground than high up. The velocity of translation was measured by watching the progress of the balloon's shadow, thrown by the moon, on the ground. At sunset, after passing through an abundant rain in a cloud, M. Bunelle found a magnificent sky and agreeable temperature, the air moving from the south and being warmer than that near the ground. After 5 p.m., several falling stars were seen, and it afterwards appeared they had not been visible from the ground.

Letter on Relations between the Sun-Spots, Earthquakes in the Antilles and Mexico, and Volcanic Eruptions over the Entire Globe.—M. Poëy.—The writer gives a table with 786 volcanic eruptions, throughout the surface of the globe, from 1749 to 1862. The maxima of eruptions correspond to the minima of solar spots, and the minima to the maxima of spots. The table also gives a list of 38 *seismic tempests* in Antilles and extending to America, &c.—meaning, by the expression, periods of convulsion more or less intense. Of the 38, 17 correspond to maxima of solar spots, and 17 to minima. There are four others—1846, 1851, 1852, and 1853,—found at equal distances between the maxima and the minima of spots.

Reply to Remarks of M. Faye on Terrestrial and Solar Cyclones.—M. Th. Reye.—M. Faye (the writer says) does not answer the following questions as to the "machine" he represents the *trombe* to be:—Why it acts almost exclusively in summer and heat (especially on burning deserts), also when the air is calm; why the atmospheric pressure is diminished at its base, instead of increased; why dust and light objects rise into its interior; why uprooted trees and like objects are found afterwards lying in directions converging towards the base of the *trombe*. All these effects are against M. Faye's theory. [M. Faye made some remarks in reply to this communication].

Variable Period at Closure of the Voltaic Current—M. Cazin.—Reply to M. Blaserna.

Pluvial Régime of the Torrid Zone in the Basin of the Atlantic Ocean.—M. Raulin.—The author previously showed that in France most rain falls in the interior during the hot months, and in the littoral regions during the cold. He finds analogous differences, much more pronounced, in the torrid zone, and he shows this by tables of rainfall. In the basin of the Atlantic, *e.g.*, there is complete opposition in the west, in America, between Mexico, Central America, Venezuela, and the Antilles, on the north, and New Grenada, the Guyanas, and Brazil, on the south; and in the east, in Africa, between Senegambia and the Cape Verd islands, on the north, and Guinea and the islands of Ascension and Saint Helena on the south.

Conditions of the Formation of Octahedral Borax.—M. D. Gernez.—It is known that borax forms two hydrates—the one containing 5 equivalents of water, and crystallising in regular octahedrons; the other containing 10 equivalents, and forming oblique rhombic prisms. The octahedral crystals are commonly considered stable only at relatively high temperatures. The author, however, finds that both the prismatic and the octahedral form can be produced at low temperatures. The temperature of 56°, which has been indicated as the inferior limit for the production of prismatic borax, is in reality only a temperature near the higher limit at which the production of prismatic borax has been observed, since this salt loses a part of its water at this temperature.

Absorption of Dry Ammoniacal Gas by Cane-Sugar.—M. E. Laborde.—On employing absolutely dry sugar, and submitting it to the action of a current of ammoniacal gas, dried over a long column of quick-lime, the sugar becomes at first opalescent, and takes the waxy consistence described by Raspail, but in the course of twelve hours it liquefies, and flows on the surface of the tube in which it is contained; 100 parts of sugar absorb 7·83 of ammonia. On exposure to the air, the sugar loses the ammonia which it had absorbed. At the end of three months, the sugar retains only about 0·37 per cent, and has still a very pungent flavour. Glucose, similarly treated, liquefies very rapidly, becoming coloured, and forming a crystalline product.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18, December 8, 1873.

Influence of Temperature upon the Chemical Development of Heat.—Julius Thomsen.—A physico-mathematical paper. The author shows that the influence of temperature upon the chemical development of heat is very considerable when the process occurs in the moist way, and that consequently all results of thermo-chemical determinations in the moist way are valid only at the temperature of the specific experiment.

The Magic Lantern as a Means of Illustrating Chemico-Physical Lectures.—Hermann Vogel.

Method of Determining Anthracen.—E. Luck.—The author dissolves 1 grm. of the sample of commercial alizarin in question in 45 c.c. glacial acetic acid at the boiling-point in a small flask. The solution, if needful, is filtered whilst boiling, and a solution of 10 grms. of chromic acid in 5 c.c. of water and 5 c.c. of glacial acetic acid is gradually added, the liquid being kept gently boiling. The addition of this mixture is continued till a distinct and permanent yellowish-green colour appears, or till after prolonged boiling a drop of the liquid, placed upon a clean silver coin, produces a reddish spot (chromate of silver). The whole is then allowed to cool, gradually diluted with 150 c.c. of water, filtered after standing for some hours, the chinon is washed upon the filter, first with water, and then with hot very dilute potassa lye, then again with water, dried at 100° C., and weighed. After weighing the chinon is removed from the filter, and the latter is weighed again. Thus the nett weight of the anthrachinon is obtained, to which 0·010 grm. must be added, that quantity having been dissolved and removed by the above-directed quantity of glacial acetic acid and water Commercial chromic acid often contains lead.

Reaction with Formiate of Soda.—V. von Richter.—A reply to V. Meyer's paper.

A New Synthesis of Glycocol.—A. Emmerling.—If cyanogen gas is treated at a boiling heat with concentrated hydriodic acid glycocoll is formed as follows:—

$$2CN + 5HI + 2H_2O = C_2H_5NO_2 + NH_4I + I_4.$$

Nature of the Elements.—J. A. Groshans.—A continuation of the author's former papers on the same subject. It is not suited for abstraction.

Preparation of Meta-Toluidin from Commercial Aniline.—L. Schad.—The author operates upon aniline of the following boiling-points:—

196°	.. .. ..	27 per cent.
198°	.. .. ..	60 „
200°	.. .. ..	77 „
202°	.. .. ..	85 „
204°	.. .. ..	90 „

10 lbs. of this aniline are converted into nitrate with nitric acid of sp. gr. 1·2. The hot liquid is stirred till cold, the crystalline powder is filtered off and strongly pressed. The pressed cake is dissolved in so much boiling water that the hot solution stands at sp. gr. 1·1. It is then stirred till cold, filtered, and the crystals pressed again. These are then dissolved in so much boiling water that the solution marks 1·075. It is then stirred till cold, filtered, and the crystals pressed again. It is again dissolved in boiling water to sp. gr. 1·05, stirred till cold, filtered, and the crystals pressed once more. The mass thus obtained yields, on decomposition with caustic soda and rectification, an oil which is contaminated only with bases boiling at higher temperatures. To remove the latter the oil is converted into chloride by means of hydrochloric acid of 20 per cent, stirred till cold, and the mother-liquor removed with the Bunsen filter-pump. The crystals are twice dissolved in a minimum of boiling water, stirred till cold, and the mother-liquor pumped away. After decomposing the last crop of crystals with caustic soda and rectifying, meta-toluidin is obtained with a constant boiling-point of 197°, and showing neither the reactions of aniline nor para-toluidin.

Phosphide of Antimony.—W. Ramsay. (A preliminary notice.)—R. W. E. Macivor, of the Andersonian University, Glasgow, has succeeded in forming phosphide of antimony, PSb, as a red powder, insoluble in benzol, ether, and bisulphide of carbon, and containing—

Antimony	.. .. ..	79·48
Phosphorus	.. .. ..	20·21
		99·69

Optical Properties of Certain Compounds of the Pentan Series.—M. Ley.—A lengthy paper, not suited for abstraction.

Addition of Cyanamid.—E. Baumann.—The author has obtained and examined alakreatinin, alakreatinin-chlorzinc, besides experimenting on the addition of substituted cyanamids, and on the behaviour of cyanamid with acids.

On Cholic Acid and the Protein Compounds.—F. Baumstark.—The author recognises in cholic acid that constituent of the albumenoid bodies which reacts with Pettenkofer's test.

Hexa-hydrois-oxylol.—F. Wreden.—A preliminary communication.

Chemistry at the Forty-Sixth Meeting of German Naturalists and Physicians at Wiesbaden.—Reported by Messrs. Flight, Mayer, Michaelis, and Oppenheim.—H. F. Weber read a paper on the specific heat of graphite and diamond, and of carbon in its combinations.

The President of the Chemical Section, Löwig, of Breslau, read some papers by Tollens, of Gottingen, on two isomeric bibrom-propionic acids, on an acid formed by boiling sugar with dilute sulphuric acid, and on the compounds of starch with potassa and soda.

Wibel explained his new water air-pump.

Horsford gave a communication on the reduction of carbonic acid to carbonic oxide by phosphate of iron. An ethereal solution of chlorophyll is resolved by hydrochloric acid into a blue and a green stratum. The first mentioned contains iron, lime, and phosphoric acid—the constituents of Vivianite. Zinc and sulphurous acid destroy the colour. Carbonic acid, enclosed with ferrous phosphate in a tube, is gradually decomposed, while the salt of iron turns blue. About one-sixth of the carbonic acid is, in a few days, converted into carbonic oxide.

Graebe and Caro communicated an interesting paper on the constitution of rosanilin. They ascribe to rosolic acid the formula $C_{20}H_{16}O_3$.

Oppenheim gave an account of his researches on the product of the reaction of oxide of mercury upon benzamid.

Lossen read a paper on amidic derivatives of hydroxylamin.

Scheibler exhibited two specimens of arabinose, $C_6H_{12}O_6$, a gum-sugar which he had recently described.

V. Meyer gave the results of his experiments on the action of formiate of soda upon sulpho-benzoic acid and benzoic acid. Wisliçenus added a notice that the observations of Richter have no connection with Meyer's reaction. He also made a communication on ethylenlactic acid.

In the second session, September 20, Meyer read a paper on the action of sulphuric acid upon nitro-ethan.

Wurston gave a short communication upon fulminic acid, for which he proposed the formula, $H(NO_2)C_2NH$.

Bœttger called attention to some new interesting lecture experiments on active hydrogen and active oxygen.

Weith treated of desulphurising diphenyl-sulph-urea by oxide of mercury.

Petersen gave his opinion as to the chemical location of the benzol derivatives.

Fittig read a paper on chinons.

In the third session Himyl gave an account of Schorer's water air-pump.

P. Rasenach described a hydrocarbon obtained from the portion of coal-tar which boils at the highest temperature.

Michaelis exhibited his derivatives of phosphenylchloride.

Staedel described the reduction of benzophenon.

Blockmann reported on two analyses of coal-gas, before and after passing through porcelain tubes at 1000°. The hydrogen had increased, and all heavy hydrocarbons had disappeared.

Walter treated on the "changing valence" of nitrogen, phosphorus, &c.

Bauman gave a paper on the addition of cyanamid.

Staedel spoke on chlorinised ethans.

Gscheidlen exhibited an apparatus for mixing two solutions without access of air.

Thudicum contended against the accuracy of Strecker's formula for bilirubin, on the ground that hexatomic acids were unknown in organic chemistry.

Heumann pointed out certain uniformities in the melting-points of chlorinised azo compounds of benzol.

In the Section of Agricultural Chemistry, Wolff gave an account of the use of cockchafers as food for pigs. The chitin was (as might be expected) found quite indigestible.

A. Mayer gave an account of some important experiments undertaken to decide as to the power of absorbing ammonia—gaseous or in aqueous solution—possessed by the parts of plants *above* the surface of the ground. A variety of plants examined were found to possess this power, but, at least under the circumstances observed, a normal growth of plants seems impossible if the introduction of nitrogen through the roots be excluded. The *leguminosæ* have, in these experiments, shown no especial power of absorbing ammonia by their leaves and stalks, or of assimilating the trace of combined ammonia present in the atmosphere.

Kreusler reported on the accuracy of Will and Varrentrap's method of determining nitrogen in albuminates. In accordance with Maecker and Petersen, but in contradiction to Seegar and Nowak, he found the soda-lime process trustworthy, even in case of albuminates. He pointed out that the soda-lime of commerce is often contaminated with nitrates and nitrites.

Fleischer gave results on the respiration of sheep.

Wildt gave an account of experiments on the secretion of hippuric acid. He considers that the cuticular substance of the vegetables consumed furnished the hippuric acid. Rabbits fed on pure grass yielded a trace of hippuric acid; if fed on clover, but little; but if allowed to eat dandelion a considerable quantity.

Neubauer and Canstein discoursed on the movement of sap in the vine, and on the qualitative composition of this liquid.

Mayer gave statistics on the results of manures.

Wolff spoke on water cultivation, and on the influence of different doses of phosphoric acid upon the development of the oat plant.

In the Mineralogical Section Flight described his experiments on the colours of the diamond. A rose-coloured diamond of 29 carats, exhibited at Paris in 1867 by Coster, of Amsterdam, was bleached in four minutes on exposure to diffused light, but resumed its colour when heated in asbestos, and retained it if preserved from daylight. Two dull yellow diamonds from the Vaal river were selected, one of which was preserved for comparison, while the other was subjected to modifying experiments. On being heated to redness in a current of hydrogen, it was found colourless when cold, but gradually assumed its colour on exposure to daylight. If heated in a current of chlorine the result was the same.

Flight gave an account of the "distillation method" for the determination of silicic acid as developed by himself and N. Story-Maskelyne. The description of the apparatus requires a diagram.

Flight gave last an account of the experiments of Douglas, Hermann, and Story-Maskelyne on the crystallisation of phosphorus.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 5, January 29.

Gypsum and Salt in Agriculture.—Pierre Deschamps.—The author has experimented on the use of sulphate of lime with the addition of common salt as a manure for winter tares. Salt water, as is well known, dissolves a much larger proportion of gypsum than pure water. The yield was—

	Grain. Kils.	Straw. Kils.
4 hectolitres gypsum per hectare . .	962	2400
4 hectolitres gypsum and 60 kilos. of salt	1324	4100
2 hectolitres gypsum and 200 kilos. nitrate of potash	1600	3300

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in gas-lamp blow-pipe apparatus, part of such improvements being applicable to other oil and spirit lamps. John Robert Harper, Clerkenwell, Middlesex. April 4, 1873.—No. 1251. The first part of these improvements has for its object the combination of a current of air with the jet of ignited gas or vapour as it issues from the oil or spirit vessel and jet-pipe of such apparatus. The jet-pipe is surrounded by, or enclosed within, another pipe, open at each end, so that, when the jet of gas or vapour is ignited, a strong current of air is caused to enter the pipe behind the jet of ignited gas, with which it combines, thereby increasing the intensity of the flame so produced. By reason of this improved arrangement, the flame of an auxiliary lamp can be dispensed with. According to another part of these improvements, an additional jet-pipe (or pipes) is employed to evaporate and maintain the pressure in the oil or spirit vessel, in place of the auxiliary lamp heretofore employed for this purpose. According to another part of these improvements, the oil or spirit vessel is surrounded with a water- or steam-jacket, to which heat is applied for transmitting heat to the oil or spirit vessel for producing the gas which supplies the jet or jets of the blowpipe apparatus. Another part of these improvements relates to the arrangement and construction of the safety-valves of such apparatus. The safety-valve is surrounded with a case to receive the gas when it escapes through the safety-valve and conduct it to the jet-tube, where it is consumed with the gas from the jet. In accordance with another part of these improvements, the oil or spirit vessel is formed with a chamber or passage through which the gas-jet and safety-valve tubes are conducted in order to afford ready access to the gas-cocks and apparatus. According to another part of these improvements, gas blowpipe apparatus when out of use is enclosed in a central chamber formed within an annular-chambered oil or spirit can or vessel containing a supply of benzoline, paraffin, or other cheap oil or spirit, thereby rendering the apparatus more convenient and portable. When auxiliary lamps are employed, a benzoline, paraffin, or other similar lamp is used in place of spirits of wine, as heretofore.

A new colouring matter or "dye." Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Emile Digeon and George Goldsmith, both of Paris, France). April 10, 1873.—No. 1331. This invention relates to the preparation of a yellow colouring matter from the roots of the asphodel (a plant of the order Liliaceæ). The colour is obtained by decoction, or preferably by extracting the juice by any known means. By dipping fabrics dyed with this yellow in an alkaline bath, shades of maroon may be obtained.

Improvements in the preservation of alimentary substances, and in apparatus for the same. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Bernard Delrieu and Jean Marie Pernoud and Co., of Lyons, France). April 16, 1873.—No. 1370. This invention is based on the desiccation of alimentary substances *in vacuo*, in the presence of hygrometric matters capable of absorbing the vapours of water as they form, preferably sulphuric acid at from 48° to 52° Baumé. The desiccating apparatus consist of a series of boxes, and of two series of air-pumps, one for producing a vacuum in each box, and the other for acting on the whole of the boxes. Each desiccating box is divided vertically into two equal parts, each half containing rows of leaden trays for the acid, and of frames for the matters under treatment, disposed alternately, to avoid congelation.

A new or improved composition for treating, impregnating, and coating wood, so as to preserve and render it impervious to water and other fluids. William Hockley, 26, Bloomsbury Square, Middlesex. April 16, 1873.—No. 1382. This invention has for its object the preparation of a composition for treating, impregnating, and coating wood so as to render it impervious to water and other fluids, being particularly applicable for treating and impregnating the interior of casks, vats, or other hollow vessels made of wood, to render them impervious to the action of the malt liquor or other fluids they are required to contain. For this purpose what is generally known as paraffin wax is employed, purified, and refined by boiling. To this gum anemie and gum galguminum are added, in the proportions of about 1 ounce each to 7 lbs. of paraffin. About the same proportion of gum copal may be combined with the above ingredients for some purposes, if desired.

NOTES AND QUERIES.

Linseed Oil.—Having considerable difficulty in procuring pure linseed oil, I would like to ask through your journal for a means of separation, the adulteration being cotton-seed oil.—F. P. C.

Coal Brasses.—Will some of your readers inform me whether coal brasses are used alone for the manufacture of sulphuric acid, or must they be mixed with other pyrites? Will the ordinary pyrites burner answer, and is the sulphuric acid very brown?—K.

MEETINGS FOR THE WEEK.

Monday, March 2.—Medical, 8.
— Society of Arts, 8. Dr. Graham, "On the Beer of the Future."
— Royal Institution, 2. General Monthly Meeting.
— London Institution, 4.
Tuesday, 3.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
— Civil Engineers, 8.
— Anthropological, 8.
— Zoological, 8.30.
— Society of Arts, 3. Consul Thomas J. Hutchinson, F.R.G.S., "On the General Features of West African Trade from Senegal to St. Paul de Loanda."
Wednesday, 4.—Society of Arts, 8. Mr. George Lund, "On Bells and Modern Improvements for Chiming and Carillons."
— Microscopical, 8.
— Pharmaceutical, 8.
Thursday, 5.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation (Ferns and Mosses)."
— Chemical, 8.
— Royal, 8.30.
— Royal Society Club, 6.
Friday, 6.—Royal Institution, 8; Weekly Evening Meeting. Sir Samuel Baker, M.A., "Suppression of the Slave Trade of the White Nile," 9.
— Geologists' Association, 8.
— Society of Arts, 8. F. Field, F.R.S., "On the Paraffin Industry."
Saturday, 7.—Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

TO CORRESPONDENTS.

A. E. S.—Our last Students' Number (No. 720, Sept. 12, 1873) would probably assist you in choosing a college.

F. A. V.—Your description is not of sufficient value to justify expense of woodcut.

A Subscriber.—Consult Crookes's "Select Methods in Chemical Analysis," published by Messrs. Longmans and Co.

J. I. Y.—A reply to your questions would necessitate a detailed chemical examination.

J. Wills.—Received with thanks.

Ganot's Two Works on Natural Philosophy, translated and edited with the Author's sanction by E. Atkinson, Ph.D., F.C.S., Professor of Experimental Science, Staff College:—

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THE CHEMICAL NEWS.

VOL. XXIX. No. 745.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 97).

SECTION IV.—PROCESSES AND RESULTS.

THE processes and manipulation necessary to the determination of an atomic weight are at all times difficult and delicate, but especially so in the case of a metal such as thallium, so readily oxidisable. This strong tendency to combine with oxygen renders the ordinarily exact processes of weighing out pure metals inapplicable to the present purpose. The chances of contact with the oxygen of the atmosphere must be reduced to a minimum, and to this end the following modes of operation were devised. The method found to be the most accurate, and that adopted in repeating the determinations, will receive a description more detailed than the first, and what may be termed approximate, methods.

Process of the Conversion of Thallium into Nitrate of Thallium.

Thallium being a metal of very high atomic weight, the change in weight in the interconversion of its compounds is comparatively too small to be estimated with any approximation to accuracy. For instance, the conversion of acetate of thallium into chloride of thallium is an operation hardly to be effected without such loss as would seriously interfere with the calculated result.† The immediate conversion of the metal into one of its salts is therefore the method affording results less liable to be affected by errors in observation; and the conversion of thallium into its nitrate has been that ultimately adopted.

Pure thallium, obtained as described, is cut into small bars with a very sharp steel knife, and dropped into a dish of pure water slightly warmed, and forming the sub-stratum to an atmosphere of carbonic acid in a vessel large enough to admit both hands easily. In this bath the original surface of the ingot is removed and rejected. The bars are then well rubbed with fine cambric to smooth down all sharp edges. Any pieces which contain pores are rejected.‡

A stoppered tube (Fig. 11) is half filled with water, and weighed. The bars of thallium are then quickly removed from the warm water of the carbonic acid bath, rapidly wiped dry with warm cambric while in the carbonic acid, and put into the weighed tube of water. It is found that no appreciable oxidation takes place during this transference, and that the whole of the moisture can be removed. The tube and its contents are then weighed again.

Fig. 12 represents a vessel for the conversion of thallium into its nitrate, the pure metal as weighed in the manner described above in a tube of water being placed in the bulb *a*, and the pure nitric acid in *b*. The tubes are accurately ground, and fitted to each other at *c*. *d* is a permanent stopper to the upper bulb, well ground. *e* and *f* are platinum wires for the support of the flask in the balance. The process of converting the thallium into its nitrate coincides in detail with this apparatus with the process ultimately adopted, and particularly described in the succeeding pages. With an apparatus of this kind the determination A was performed, the metal being purified by the process already described under *a* (p. 96).

Fig. 13 is a further improvement. The nitric acid, in acting upon the metal in *a*, evolves fumes, which mechanically carry off traces of nitrate of thallium. In the vessel shown in Fig. 12, these fumes are washed in the nitric acid, offering, however, no great advantage; but, in the series of bulbs shown in Fig. 13, *b* contains the nitric acid, which can, by means of the tap *c*, be admitted in the required quantity to the metal. The fumes are washed in the water contained in *g*, the water being evaporated to obtain the nitrate of thallium held in solution. In this apparatus, and with metal purified by the process described under the letter *a*, the determination B was effected. The metallic thallium is weighed sealed up in hydrogen in the following manner:—

The lump or ingot of pure metallic thallium prepared by the process *a*, already described, is cut up into parallelograms, all the original surface being removed with a very sharp steel knife. The parallelograms, immersed and boiled in very dilute sulphuric and hydrochloric acids, are subsequently washed, boiled repeatedly in water, and then transferred to the glass tube *a*, Fig. 14. Into this tube pass and are fused the platinum wires, *b c*, these wires being the reducing and oxidising electrodes respectively in connection with two Grove's elements. At *d* the tube is drawn out to a fine orifice, and at *e* is passed in a current of pure hydrogen prepared as before described, as shown in Fig. 15. The electric current being passed through the water, to preserve the pure metallic surface of the thallium, heat is applied until the water is entirely volatilised. At this point, and while the tube is very hot, the dry hydrogen still passing, the end of the tube at *d* is sealed up, and then the tube at *h*, previously much contracted, is closed before the blowpipe. The metal is thus enclosed hermetically in an atmosphere of pure hydrogen. The tube and its contents are then cooled for six hours, and, when cooled, weighed first in air and then in the vacuum-balance. The tube is now cut across the middle with a cutting-diamond, wrapped up in smooth platinum-foil to secure any splinters of glass which might be thrown off, and then broken with a sharp blow opposite the cut. The thallium is carefully removed from the pieces of tube, and introduced into the apparatus where the subsequent operations are to take place. The pieces of tube, with any splinters which may have broken off, are weighed, first in air and then in a highly rarefied atmosphere. The difference between the weighings of the full and empty

FIG. 11.

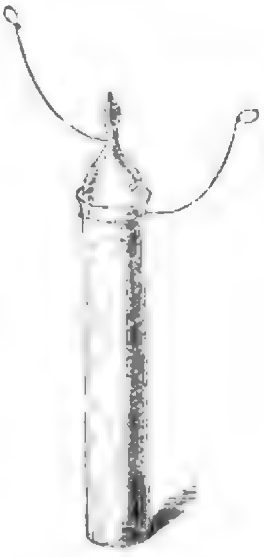
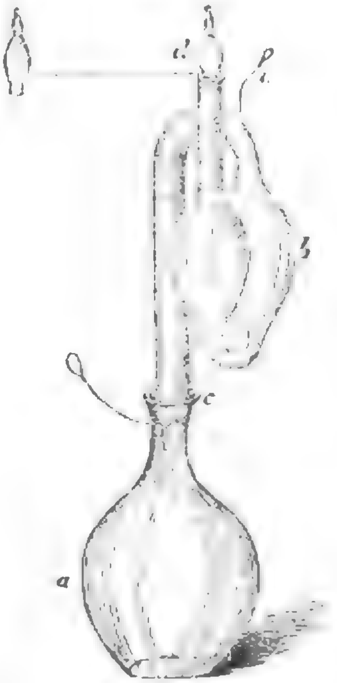


FIG. 12.



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* A Paper read before the Royal Society June 20, 1872.

† An error of one grain in the weighing accumulates to an error of one in the atomic weight.

‡ The upper surface of the fused lump is full of pores for a depth of one-sixteenth of an inch; one-quarter inch is therefore removed for greater certainty.

tube, after correcting for the hydrogen contained at first, gives the weight of thallium taken.

These two forms of apparatus were found to answer the purpose tolerably well. Several improvements, however, suggested themselves whilst the determinations were in progress, and they were finally embodied in the apparatus shown in Figs. 16, 17, and 18. In this several refinements of manipulation can be introduced which were impracticable with the former apparatus—notably, the ease with which a definite quantity of metal is introduced into the apparatus without the chance of oxidation, the simplifications introduced in the weighings consequent on having the apparatus vacuous, and the facilities obtained for the employment of the Sprengel and Bunsen pump at different stages of the operations.

Fig. 13.

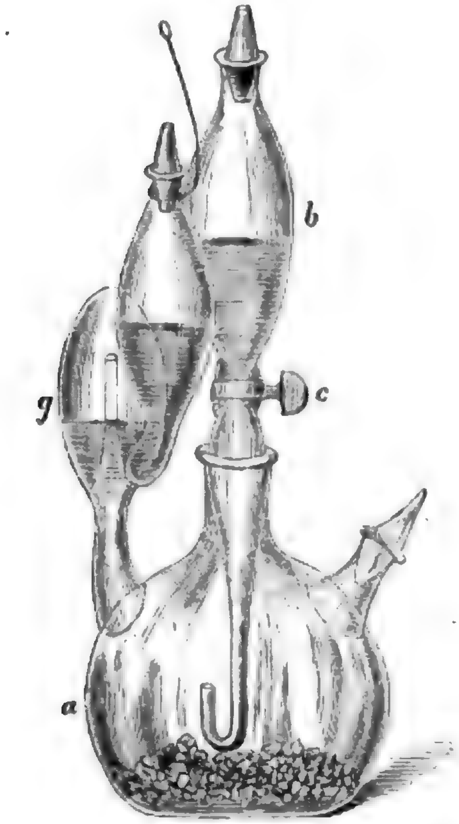


Fig. 14.

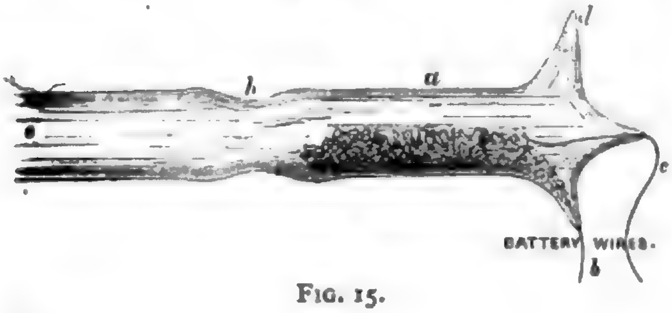
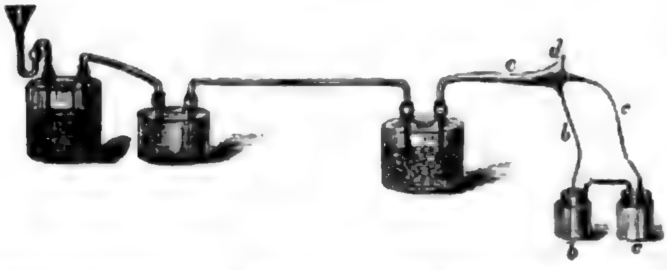


Fig. 15.



Although each determination with this improved apparatus still took many weeks for its successful performance, a great saving of time was effected when compared with that required for a determination in the apparatus first used, where months were consumed in the evaporations. As this form of apparatus was the one in which most of the determinations were effected, and, as the manipulations were attended with greater chances of accuracy than were those at first employed, I will describe the apparatus, its employment, and the several processes performed in it somewhat in detail.

Fig. 16.

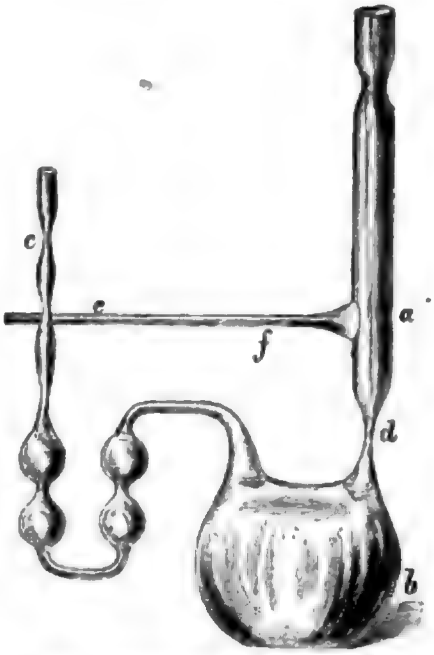


Fig. 17.

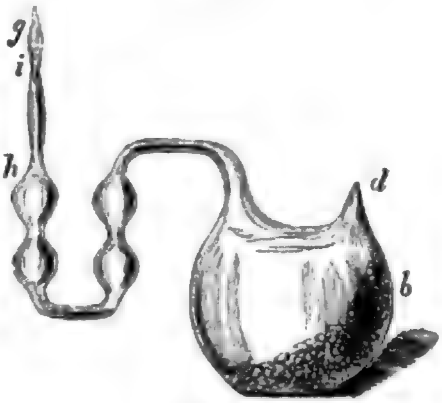
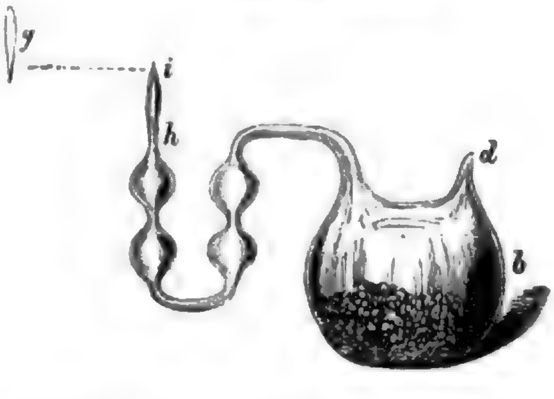


Fig. 18.



Some of the metallic thallium, prepared by one of the methods already described, is cut by means of a sharp steel knife into prisms about one-eighth inch square and half an inch long, no particular care being taken to avoid oxidation. The prisms are boiled in dilute hydrochloric acid to remove any trace of iron which the knife might have communicated. They are then washed in water, dried with blotting-paper, and introduced into the cylindrical portion *a*, Fig. 16, of the apparatus. The outer extremity of *a* is then drawn out and sealed before the blowpipe. The end *c* is also sealed up, and the horizontal tube *e* is connected to the Sprengel pump and a vacuum obtained, the apparatus and the thallium being kept warm to drive off any moisture which might have been introduced with the thallium. When the vacuum is perfect, the tube is sealed at *f*. The apparatus, sealed up and entirely free from air, is now laid on its side, and the cylinder *a* and the bulb *b* imbedded in a bath of magnesia held in a copper vessel heated by gas. The temperature is then raised to above the fusing-point of thallium (561° F.), when by careful manipulation the oxide may be separated from the liquid metal, and the greater part of the oxide collected at the closed end of the cylinder *a*. The magnesia is then removed from about the narrow part of the tube *d* (which should be somewhat long and very much contracted), and by a dexterous movement the magnesia-bath containing the apparatus is suddenly tilted up, and the liquid metal allowed to run through the contracted part into the bulb *b*. In some instances portions of oxide or of metal stick in the channel; then the operation is lost, and a fresh attempt has to be made with another apparatus; but, if the channel is entirely or in great part clear, it may be sealed up at the contraction, care being taken to apply the heat at such a place that no particles of metal or oxide are entangled in the fused glass.

The apparatus has now the form shown in Fig. 17. It is hermetically sealed, entirely free from air, and contains a certain quantity of pure metallic thallium entirely free from oxide and as brilliant as mercury.

The next operation is to ascertain the combined weight of the apparatus and metal. It is washed on the outside with dilute sulphuric acid to remove any particles of magnesia that might adhere to it, and, after rinsing with water, is dried and gently warmed. Its weight is then taken in the air-balance—not necessarily with extreme accuracy, but to enable a calculation to be made as to how much it will probably weigh in the vacuum-balance at a greatly reduced atmospheric pressure. As the substance weighed consists of thallium and glass in unknown proportions, the vacuum-weight cannot be calculated with any approach to accuracy; but it is generally easy to arrive at some approximation to the relative proportions of thallium and glass, and in this manner the probable vacuum-weight may be estimated.

The apparatus is now transferred to the vacuum-balance, and weights put which it is judged will balance it at an atmospheric pressure a few barometric inches short of a vacuum. The balance-case is then sealed up, and the exhaustion proceeded with. As the rarefaction proceeds, the beam is occasionally liberated until it is found that the apparatus and weight are in equipoise. If the barometer-gauge shows a rarefaction not equal to 25 inches of mercury, the air had better be let in, the requisite additional weight added, and the exhaustion re-commenced; but if, when the balance is in equilibrium, the rarefaction is above 25 inches, the weighing may be continued.

Two sources of error have now to be guarded against:—1. The alteration of temperature inside the iron case, consequent on the rarefaction. 2. The slow and almost unavoidable leakage of air into the balance through the iron, the numerous joints, and the stuffing-boxes. This leakage should not exceed 0·1 inch in an hour.

Equilibrium having been obtained, two or three extra strokes are made with the air-pump, and the exhaustion raised to such a point that by about six hours' leakage the balance is again in equipoise. The weights will at first appear lighter than the apparatus. The balance is allowed to remain well protected from external thermal influences, until the time has nearly arrived when the leakage of air into its interior has reduced the rarefaction to the point at which the weights and apparatus will be exactly in equilibrium. The observer now enters the room, and, after liberating the beam and setting it in oscillation, watches the movements of the index through a telescope fixed 10 feet off. By reason of the gradual leakage of air, the inequality of the oscillations gradually diminishes, until at last the arcs are of the same value. At this moment the temperature inside and outside the balance-case, the height of the barometer-gauge, and the reading of the standard barometer are observed.

Six hours are generally sufficient to restore the temperature reduced by the exhaustion; but, if the inner and external thermometers differ, I again rarefy by a few strokes of the pump, and repeat the observation after waiting for a few hours longer.

Having obtained the accurate weight in a rarefied atmosphere, the next step is to weigh the apparatus in air of the ordinary density. Air is allowed slowly to enter the balance through the U-tubes at the side, and in a few hours, when the inner and outer temperatures are uniform, the weight is again taken.

For the final adjustment of the weight, the rider may be used. I, however, prefer, as being more accurate, to place a weight slightly in excess in the pan opposite to the apparatus to be weighed, and then, having sealed up the balance, to exhaust a little beyond the point of equilibrium of weight, and continue the operation exactly as in weighing in a rare atmosphere. By taking care that the air contained in the balance shall only be half an inch or so rarer than the external atmosphere, the data afforded by the two weighings will be sufficient to enable the true vacuum-weight of the apparatus to be calculated with accuracy.

This method of ascertaining minute differences of weight, not by the addition to, or subtraction of, material weights from one arm of a balance, but by varying the density of the air in which the operation is performed, is, I believe, attended with a greater approach to accuracy than the method generally adopted. It can, however, only be adopted when the weights and the substance weighed differ in specific gravity.

(To be continued).

ON THE CONDITION IN WHICH SILICON EXISTS IN PIG-IRON.

By E. HANDFIELD MORTON, F.C.S.

The author was induced to make a few experiments upon the subject of this paper, by noticing that silica was obtained in the insoluble residue when pig-iron containing a large quantity of silicon was dissolved by dilute sulphuric acid *in vacuo* instead of silicon, which might have been expected as the result of the decomposition of the pig-iron under these conditions.

This fact appeared to clearly point out that the theory of the silicon being *intimately mixed* with the pig-iron was untenable, at least as regards this particular pig, which was a No. 1 Bessemer iron containing 4·612 per cent of silicon, and was therefore not at all unlikely to contain silicon in admixture, if that element ever occurred in pig-iron in such a condition. A considerable number of experiments were made with the view of ascertaining how far this conclusion was correct.

Weighed quantities of the Bessemer pig-iron were placed in sealed tubes with Nordhausen sulphuric acid, in atmospheres of carbon dioxide and hydrogen, and also *in vacuo*: the tubes were then heated in an air-bath by two Bunsen burners for twenty-four hours, but in every case the silicon contained in the pig-iron had been converted into silica, and a small quantity of sulphur dioxide formed in the tube, which occasioned sufficient pressure to blow the top off the tube when cracked with a file. On examining the insoluble residue from these experiments under the microscope, perfectly transparent crystals of silica were observed interspersed with opaque pieces of the same substance. When these insoluble residues were treated with hydrofluoric acid, complete solution was effected.

The next attempt to isolate the silicon in this pig-iron was made by heating weighed quantities of the iron with an excess of pure iodine in sealed tubes, all air being first displaced by carbon dioxide; the same heating arrangement being used as in the sulphuric acid experiments. At the end of twenty-four hours, all iodine vapour having disappeared, one of the tubes were opened and the contents analysed, with the following results:—

Iodine	76·432	per cent
Iron	20·013	„
Silica	1·709	„
Carbon	0·759	„
	98·913	

Directly the tube was cracked the pressure of gas blew the top off. The contents consisted of dull red lumps, the whole of the iron having been converted into the ferrous iodide, as the above figures correspond to the formula, FeI_2. There can be little doubt but that the silica which was formed in this experiment was due to a slight decomposition of the carbon dioxide, with which the tube was filled; the greatest part of the silicon having been converted in all probability into an iodine compound; for, although iodine vapour is without action upon silicon under ordinary conditions, it is highly probable that when silicon in the nascent state is presented to iodine vapour, a compound of iodine and silicon may be formed. These results were confirmed by several other similar experiments. This pig-iron was also carefully tested for graphitoidal silicon, by treating the iron with hydrofluoric acid; the insoluble residue was filtered off, and ignited to get rid of the carbon, when a mere trace of a dark powder remained, which proved to be iron.

From these results it may fairly be concluded that the silicon contained in pig-iron does not exist in a state of mechanical mixture, but exists combined with a portion of the iron as a silicide of iron, in the same manner that carbon exists as a carbide of iron, only differing from carbon in so far that it does not exist in a graphitoidal form in pig-iron. If the pig-iron used had contained any uncombined silicon, it would have been found in the insoluble residue from the experiments with Nordhausen sulphuric acid and hydrofluoric acid, as it is insoluble in even the latter acid after having been strongly heated; and as any uncombined silicon must have been heated intensely in the blast furnace, there can be little doubt that as a rule pig-iron does not contain any uncombined silicon.

The author then made the following experiments in order to ascertain whether or not the hypothesis of the combination of the silicon with the iron was correct:—0·1694 grm. of the Bessemer pig-iron was placed in a platinum boat, which was then introduced into a porcelain tube. A current of carbon dioxide was passed through the tube to displace the air, after which pure dry hydrogen was passed through until all the carbon dioxide had been driven out. The portion of the tube which contained the boat was then heated for five hours to a very bright red heat in a Fletcher's gas furnace, the current of hydrogen being maintained until the tube was cold. The boat was then withdrawn and weighed, when it was found that a loss in weight of 0·004 grm. had taken place. The gas, as it left the apparatus, was passed through a wash-bottle containing a weak solution of pure caustic potash (prepared from alcohol); at the end of the experiment this solution was made acid with pure hydrochloric acid, evaporated to dryness, and ignited, when an insoluble residue of silica was obtained which gave 0·344 per cent of silicon on estimation. The iron in the boat (which, after its withdrawal from the tube, showed no sign of oxidation) was analysed, with the following results:—

Iron	92·018	per cent.
Silicon	4·130	„
Graph. carbon	1·622	„

For comparison with the above analysis is subjoined the analysis of the pig-iron used:—

Iron (by difference)	92·375	per cent.
Graph. carbon	2·800	„
Silicon	4·612	„
Phosphorus	0·110	„
Sulphur	0·103	„
	100·000	

This shows that there was a loss of silicon to the amount of 0·482 per cent.

The above experiment was repeated several times with almost identical results. It will be observed that the amount of silicon found in the caustic potash solution very nearly corresponds with the amount of loss of silicon sustained by the iron operated upon; thus, 4·130 per cent + 0·344 per cent = 4·474 per cent silicon, instead of 4·612 per cent, the difference being 0·138 per cent.

In the event of the silicon being in combination with the iron, the author calculated in the above experiment upon the reducing power of hydrogen being able to decompose the silicide of iron, with the formation of siliciuretted hydrogen, which would be decomposed by the caustic potash solution; and this appears to have taken place. Possibly the temperature of molten iron is required to effect the decomposition of the whole of the silicide of iron, or else the attraction of iron for silicon is so strong as to defy, in great measure, the reducing power of hydrogen. This last hypothesis is by no means improbable when the high temperature of molten iron is taken into account; for the fact is pretty generally admitted that chemical affinities are frequently reversed in the presence of an intense temperature.

A sample of white pig-iron containing a large quantity of silicon having been given to the author, he thought it might be interesting to ascertain whether hydrogen had the same effect upon the silicon contained in the white iron as it had upon that contained in the Bessemer iron used in the preceding experiments.

0·1420 grm. of the white iron was heated in the same apparatus, and under the same conditions that existed in the preceding experiments, for six hours at nearly a white heat. When cold the iron was analysed, as was also the caustic potash solution, with the following results:—

Iron	89·201	per cent.
Graph. carbon	1·060	„
Silicon	4·287	„

Caustic potash solution: Silicon = 0·494 per cent.

The composition of the white iron used is shown by the following analysis:—

Iron	90·000	per cent.
Graph. carbon	2·975	„
Silicon	4·704	„
Undetermined	2·321	„
	100·000	

The amount of silicon found in the caustic potash solution is 0·077 per cent more than is required to account for the loss of silicon sustained by the iron used, which amount may be said to be within the limits of error of experiment.

The following table shows the amounts of loss of silicon sustained by the iron used in these experiments, and also the amounts of silicon found in the potash solutions:—

	Loss of Silicon.	Silicon found in Potash Solution.
Bessemer pig-iron	= 0·482 per cent.	0·344 per cent.
White „	= 0·417 „	0·494 „

On comparing the results obtained from the two kinds of iron used, it is evident that the effect of hydrogen upon the silicide of iron is identically the same in both cases, and this has led the author to believe that the amount of silicon lost by the iron in each case is due to the silicide of iron containing an atom of non-saturated silicon, or, in other words, that the silicide of iron was supersaturated, and consequently the non-saturated atom of silicon united with the hydrogen, leaving a lower silicide of iron undecomposed. Whether this is the case or not can only be decided by treating samples of iron containing smaller quantities of silicon in the same manner, and observing whether there is any loss of silicon sustained by them. These and other experiments upon this subject the author hopes to communicate shortly.

Another curious point to be noted in the experiments with hydrogen is that a loss of graphitic carbon has occurred both in the Bessemer and white iron, and the loss in each case is somewhere about the same amount. The author is at present unable to offer any definite explanation of this circumstance, except that the loss cannot be due to the action of oxygen, because, if that had been the case, an oxidation of the iron must have been apparent.

In conclusion, it may be fairly considered, from these experiments, that silicon in pig-iron is contained as a chemical compound of iron and silicon, and not as a mechanical mixture.

Newport, Mon.

ON THE ESTIMATION OF TANNIC ACID.

By C. ESTCOURT, F.C.S.

In connection with my duties as Public Analyst to the City of Manchester a large number of teas have been examined by me.

The most serious difficulty in a tea analysis has been the estimation of tannic acid, which by either the gelatin or the antimonial methods is extremely tedious. The extreme care necessary to avoid adding too much, and the trouble of filtering, &c., when too little of the reagent is added, are difficulties the analyst would gladly avoid. When in addition the continual titration necessary with both gelatin and standard tannic solutions is mentioned, no more need be said, especially as the experiments detailed at the end of this paper show that a *fixed* proportion of the tannic acid sold as pure is not *precipitated* by gelatin or by antimonial solutions when applied in the ordinary way. Lowenthal's method, consisting of titration with potassium permanganate, dilute sulphuric, and indigo solution as indicator, gives very good results when tannic acid alone is present. As teas contain a considerable quantity of gallic acid, Lowenthal's process alone is not applicable to their analysis. Neubauer modified the foregoing process by titrating one portion of the original solution as above, and then adding to a fresh portion of the solution a quantity of animal charcoal, filtering off, testing solution with sodium acetate and ferric chloride. If no tannic reaction was perceived he titrated as before with potassium permanganate; estimating the difference between the first and second titration as being tannic acid. The animal charcoal, however, in addition to tannic, takes up gallic acid also, so that this method cannot be applied to tea analysis.

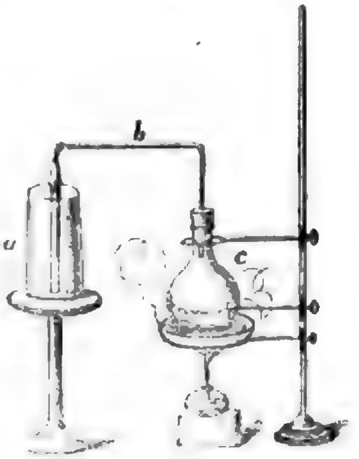
After a number of experiments with potassium permanganate and dilute sulphuric, *without* the indigo solution, I found that although constant results were obtainable in colourless solutions (for instance, standard tannic, 20 c.c., made up to 400 c.c.), yet in solutions such as tea extracts, the colour interfered with the delicate rose-pink, which indicated the termination of the reaction.

I next tried another series of experiments, first titrating say a measured quantity of tea extract, or of standard tannic solution, with permanganate, dilute sulphuric, and indigo solution, then precipitating an equal quantity of the same solution by a concentrated solution of gelatin added in excess. When the gelatin is filtered off, and the solution titrated with potassium permanganate, &c., (golden yellow being the indication of end) the difference between the two results should certainly indicate the tannic acid alone.

Having ascertained that a large excess of gelatin solution did not affect the permanganate titration, it remained to provide an easy method of filtration.

Mr. J. B. Cooke in the Chemical News, vol. xxvii., p. 261, described a method which he employed, depending upon the production of a partial vacuum in a small flask. I found his method rather difficult of application, and devised the following modification:—

a is beaker containing solution to be filtered. *b* is tube passing through caoutchouc cork at one end, and at the other connected by rubber tubing with a piece of glass tubing filled lightly with cotton-wool. This short piece of tube should be of rather larger bore than the other portion. The flask is supported on a ring over a porcelain basin full of water at boiling-point. To filter, the cork and tube are removed from the flask, and two drops of alcohol are rinsed round it. The flask is then placed in position on retort-ring, with flask-bulb dipping into the boiling water. In a few seconds the cork should be fitted in without removing flask, and the beaker should be placed under the end of the cotton-wool tube, when, on depressing it below the surface of the solution to be filtered, bubbles of air will be seen escaping. Allow this to proceed for one minute, then elevate the beaker so that the cotton-wool tube may touch the bottom, remove the light and the water-bath, and the filtration will commence. It may be hastened by the application of a wet cloth to the flask. In practice most tea solutions (if they have been heated with the gelatin solution to boiling, over naked light) give a clear filtrate at once; if, however, the filtrate comes through opalescent, the remedy is to boil it in the flask for a minute, and pass it through the apparatus again. When this has been done the operation has scarcely occupied twenty minutes altogether.



Reagents Required.

	Grms. per Litre.
Strong gelatin solution (with 1 grm. alum), say	9
Fresh standard solution of tannic acid	2
" " gallic acid	2
Solution of potassium permanganate	1·58
Dilute sulphuric acid	1 to 4 of water.

Solution of indigo paste in water about 30 grms. per litre, titrated so that at least 5 c.c. of permanganate solution will be required to produce golden-yellow tint, in 20 c.c. of indigo solution when 10 c.c. of the dilute sulphuric acid are added, the whole being made up to 800 c.c.

I do not find this process so easily applicable in all solutions containing tannic acid, but have found it expeditious and constant in results in tea, oak-galls, sumach, &c. I need scarcely add that a little alum in some cases facilitates the precipitation greatly. To estimate the tannic acid in tea it is necessary to *boil* it, as the exhaustion of tea by even large quantities of boiling water. though it dissolves out *almost all* the gallic, and a great proportion of the tannic acid, leaves behind a considerable quantity of tannic acid, which may be extracted by boiling. I believe that the *relative* quantities of tannic and gallic acids in tea may, as well as their absolute quantities, afford very useful information, and these can be ascertained with perfect exactness by the method I have adopted.

I conclude by giving details of a few of the experiments, which show conclusively that, with the gelatin or antimonial process, at least 30 per cent of the so-called pure tannic acid (used for standard) is not precipitable by gelatin or tartar emetic, and is therefore possibly not tannic; or else that more than 30 per cent of the compound formed is soluble in the quantity of liquid used in ordinary analyses.

Experiments.

20 c.c. indigo solution, 10 c.c. H_2SO_4 made up to 800 c.c. 6·3 c.c. of permanganate solution produce golden-yellow.

50 c.c. tannic solution + 20 c.c. indigo + $10H_2SO_4$, made up to 800 c.c. 62·2 (−6·3) c.c. permanganate produce golden-yellow.

50 c.c. gallic solution + 20 c.c. indigo + $10H_2SO_4$ made up to 800 c.c. 89·8 (−6·3) c.c. permanganate produce golden-yellow.

50 c.c. tannic precipitated by excess of gelatin, warmed, filtered, and + 20 c.c. indigo solution + $10H_2SO_4$ made up to 800 c.c. 34·0 (−6·3) c.c. permanganate produce golden-yellow.

Thus, *minus* the quantity due to the indigo solution, we have—

50 c.c. gallic acid require 83·5 c.c. permanganate.
50 c.c. tannic acid require 55·9 c.c. permanganate.
50 c.c. tannic acid, after precipitation by gelatin, require 27·7 c.c. permanganate.

Now if it is assumed that the so-called pure tannic acid is really pure, and contains nothing else, then exactly *one-half* (50 per cent) of the tannic acid solution forms with gelatin a soluble compound, and, refusing precipitation, is then oxidised by the potassium permanganate. Then 50 c.c. of the tannic solution contain exactly 0·1 grm. of tannic, and by this process its equivalent is 28·2 c.c. of permanganate.

If, however, as appears not at all improbable judging by the results of many experiments (the few I give being only fair examples) the unprecipitable matter is not tannic but gallic acid, then the standard solution of tannic acid would stand as follows:—2·0 grms. per litre would, in 75 c.c. of it, contain 0·1 grm. pure tannic, and would by the before-detailed process be represented by 42·3 c.c. permanganate of potassium.

I hope to succeed in separating the really precipitable portion from the soluble; it will then not be difficult to try whether the reaction is simply due to the solubility of tannate of gelatin in excess of gelatin. In any case the discovery that the quantities soluble and insoluble are constant is interesting, and will, I hope, cause other enquirers to take the matter up.

January 27, 1874.

ON PHENOL AS A PROBABLE SOURCE OF INDIGO.

By Dr. T. L. PHIPSON, F.C.S., &c.

In my note "On Phenol-Cyanine" (described in Chemical News, vol. xxvii., p. 299) I held out the probability that indigo might some day be made from it; but phenol-cyanine, according to my analysis, of this new substance, only obtained hitherto in very small quantity, contains C_{12}, whilst indigo has C_{16}. I have since endeavoured to introduce four more equivalents of carbon into the composition of phenol-cyanine.

(1). Phenol-cyanine was melted at a very moderate temperature with acetate of soda, and the product dissolved in concentrated sulphuric acid. On adding an excess of water, a sulpho-acid of a dark purple colour is precipitated.

(2). A similar experiment was made with phenol-cyanine and nitro-naphthaline, equal equivalents of each, for—

$$\frac{C_{12}+C_{20}}{2}=C_{16}.$$

The same dark purple sulpho-acid was likewise precipitated by water.

(3). These sulpho-acids, mixed and saturated by ammonia or carbonate of ammonia, gave a small quantity of purple black product, insoluble in water and alcohol, but soluble in concentrated sulphuric acid, producing a dark emerald green solution. This product is very similar, if not identical, to the black indigo produced when the leaves are badly fermented.

THE ESTIMATION OF SILICON, GRAPHITE, MANGANESE, ALUMINIUM, AND CALCIUM IN PIG-IRONS, &c.

By CHARLES H. PIESSE,
Public Analyst for the Strand District.

(Continued from p. 57.)

B. *Manganese.*

The filtrate from the silica and graphite is, after dilution with distilled water, heated to boiling, and a little powdered $KClO_3$ thrown in to ensure the existence of all the iron as per-salt. To ensure this condition it is advisable to test the liquid, by placing one drop of it upon a white porcelain surface, and adding thereto one drop of very dilute solution of K_3FeCy_6 (strength about 0·5 grm. in 300 c.c. of H_2O). To the boiling liquid add then, by means of a pipette, a saturated solution of Na_2CO_3 (taking care to keep the beaker covered, to prevent loss from spirting) until it is nearly neutralised, which will be indicated by a few flakes of the precipitate remaining undissolved, and being careful to keep the liquid boiling the whole time. Pour in, then, 35 to 40 c.c. of a saturated solution of sodium acetate,* and keep the whole well stirred until tranquil boiling sets in, and then let the boiling proceed for a quarter of an hour. Heat, in the meantime, a large stoneware fluted funnel (about 6" diameter at the top), and place upon it an appropriately-sized filter-paper, and then pour in the contents of the beaker; cover the funnel at once with thick folds of blotting-paper, or a wooden disc made for the purpose, in order to prevent the lowering of the temperature. When the filtration is complete, wash the precipitate by pouring upon it about 100 c.c. of boiling distilled water to which a few drops of the solution of sodium acetate have been added, previously replacing the beaker containing the filtrate by an empty clean one, in case the washing-water should carry with it any of the precipitate, thereby necessitating another filtration. When the whole of that quantity has filtered again, wash with 100 c.c. of water with all the same precautions.

A yellowish or reddish tint of the filtrate indicates the presence of a trace of iron, and if that exists the whole must be boiled, a little $KClO_3$ added, and about 10 c.c. of the sodium acetate solution poured in, the boiling continued for fifteen minutes, and the filtration effected as before. But this will never occur if the acid ferric solution has been carefully neutralised (whilst boiling) with Na_2CO_3.

The filtrate, mixed with the washings (should measure not more than about 450 to 500 c.c.), is rendered faintly alkaline by the careful addition of NH_4HO, and heated or cooled, as the case may require, to about 120° F., and two or three drops of bromine then poured in. After the Br has disappeared about 3 to 5 c.c. of NH_4HO are added, and then, the beaker being covered, is allowed to stand for eighteen hours, the temperature being kept, if possible, at about 100° to 120° F. throughout that period. The precipitate consists of manganic hydrate. Before filtering, boil the liquid; the particles of the precipitate are thereby caused to cohere and sink, and, moreover, the liquid whilst hot passes much more rapidly through the filter-paper. Wash the precipitate by decantation, and finally on the filter, after which it must be dried, ignited, and weighed. Ignition must be repeated until the weight remains constant. The precipitate is then Mn_3O_4. Multiply the weight of it by 72·107, and divide the product by the weight of the iron employed (actually the same as that for silicon and graphite), and the product will represent the percentage of manganese present in the sample under examination.

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* Ammonium acetate may be used if sodium acetate cannot be obtained free from calcium acetate.

C. *Calcium.*

Evaporate on a water-bath, in a platinum dish, the filtrate from the manganic hydrate until it can little more than retain all the salts that are in solution; transfer it then to a beaker, make it strongly alkaline by the addition of NH_4HO, and add some solution of ammonium oxalate. After allowing the beaker and contents to stand for about twelve hours, the liquid is decanted from the small white precipitate, which is then thrown on to the filter, thoroughly washed, dried, ignited till constant, and the final weight taken. The precipitate consists then of lime, CaO; its weight is multiplied by 71·428, and the product, divided by the weight of the iron employed, gives as result the percentage of calcium present in thee sample.

The results of many analyses of pig-irons made by me lead me to believe that calcium exists as such in nearly all pig-irons, the rule being, with pure irons, that where the greater quantity of carbon exists, there also will be found the greater quantity of calcium. To the subject of the quantity of calcium found in various brands of pig-irons, I propose to return at a future period.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 27th, 1874.

R. Angus Smith, Ph.D., F.R.S., &c., Vice-President, in the Chair.

Mr. John Watts, Ph.D., was elected an Ordinary Member of the Society.

"*On a Source of Error in Mercurial Thermometers*," by Thomas M. Morgan, Student in the Laboratory of Owens College.

While engaged in distillation, a fact has come under my observation which, although it has been noticed before, does not appear to be very generally known, and has not, so far as I have seen, been recorded.

The thermometer, which was placed in a Wurtz tube so that the column of mercury was entirely surrounded by the vapour of the distilling liquid, was found after some days to indicate 3° too little—a discrepancy caused by volatilisation from the surface of the column of mercury and condensation on the upper part of the tube. By causing the mercury to flow to the end of the tube and back, the condensed portion was gathered up, and the correct temperature indicated. It has since been observed that after each day of distillation, with liquids boiling between 60° and 100° C., a quantity of mercury equal to 1° or 1·5° volatilises, and that this quantity is scarcely perceptible when condensed on the surface of the bore. The thermometer in use was about the ordinary size, with a scale of 360°.

I am informed that Geissler sometimes encloses a little hydrogen in his thermometers, in order that volatilisation may not go on so rapidly.

CORRESPONDENCE.

ALUM IN BREAD.

To the Editor of the Chemical News.

Sir,—In reply to Mr. Jones, whose letter appeared in the last number of the Chemical News, I beg to say that the circumstance of the presence of chloride of sodium in bread had not escaped my attention, and that the possibility of getting chloride of aluminium had been made the subject of investigation. It occurred to me that phosphate of alumina and chloride of sodium might possibly react at a red heat, and yield volatile chloride of aluminium and phosphate of soda; but on making the experiment I failed to notice anything of the kind.

Should any one still fear that such a reaction might cause him to overlook alum in bread, there is a very obvious remedy, viz., the putting of a little carbonate of soda into the bread before submitting it to incineration.

I must confess some degree of distrust in Mr. Jones's observation that common salt, alumina, and sulphuric acid yield the volatile chloride of aluminium; this is, however, matter of experiment, and could be easily settled. Be it as it may, I have run no risk of that kind in the recent cases. In the cases which have given rise to so much controversy in the newspapers, I put 1 c.c. of sulphuric acid into the platinum dish, diluted with a considerable quantity of distilled water, and then boiled down until fumes of hydrochloric acid began to come off; I then diluted again and boiled, and certainly ran no risk, either of loss by volatilisation or by failure to dissolve. I did not employ oxygen gas, knowing that exception might be taken to the result if I had done so.—I am, &c.

J. Alfred Wanklyn.

March 3, 1874.

ANALYSIS OF NATIVE PHOSPHATES OF ALUMINA AND IRON.

To the Editor of the Chemical News.

Sir,—A lengthened and extensive experience in the analysis of phosphate of alumina and iron has convinced me that the following precautions are absolutely necessary to insure accurate and reliable results:—

(1). *Determination of the Water, Mechanical and Combined.*—The raw phosphates are remarkable for the facility with which they lose water. Even at temperatures much below 212° F., prolonged exposure removes a large proportion of their combined water. There is invariably a loss of moisture during the grinding operation (however expeditiously conducted), amounting sometimes, in fact, to as much as 1 or 2 per cent. To ensure concordant results, therefore, by different chemists, it is imperative that the total water (= loss by ignition) be determined by igniting the whole, or a large portion, of the sample, previously crushed *as rapidly as possible* to the size of peas, but not on any account *ground*.

(2). *Determination of the Phosphoric Acid in the Calcined Mineral, after it has been Ground and Mixed.*—It is well known that the molybdic method is the only one suitable for the determination of phosphoric acid, where much iron and alumina are present, and it is therefore necessary to adopt it in the case of these minerals. It is, I suppose, scarcely requisite to add that soluble silica should be separated before precipitation, or it will go down with the phosphoric acid.

The necessity for making these suggestions has arisen from the great trouble and annoyance I have experienced from differences in the results obtained by different chemists of high standing from identical, thoroughly mixed, and representative samples.—I am, &c.,

D. E. F.

ESTIMATION OF CARBON AND SILICON IN PIG-IRONS.

To the Editor of the Chemical News.

Sir,—I am indebted to Mr. Allen for the suggestion contained in the latter part of his letter which appeared in C. N., vol. xxix., p. 91, that the $BaSO_4$ would be more rapidly precipitated by the partial neutralisation of the filtrate, &c., but the results of a very great number of estimations of sulphur—I admit chiefly in irons containing but little sulphur—by various processes has led me to the belief that the error or difference is not a fraction of what Mr. Allen asserts it to be.

Mr. Allen's presumptions lead him quite astray when they lead him to suppose that my experience is confined to the analysis of irons containing but little graphite; my experience resulting chiefly from the analysis of irons which are among the richest in graphite of any to be found in this kingdom; and I repeat, that with a properly heated muffle the graphite can be entirely burned off in "two or three minutes." I admit that the trouble of taring a dried filter makes the process an objectionable one, but not more so than diluting a solution of caustic potash so that it will easily filter, and then evaporating that filtrate, &c., as recommended by Mr. Allen. I think that that is a detail which may well be left to the choice of the operator.—I am, &c.,

Charles H. Piesse.

PS.—I am greatly pleased with the process given by Mr. John Parry in C. N., vol. xxix., p. 86, and I believe that it is destined to supersede the other processes generally in use for the estimation of manganese in spiegels.

303, Strand, February 23, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 12, 1874.

Distribution of Magnetism in Soft Iron.—M. Jamin.—The experiments were made with an iron bar having two bobbins at its extremities traversed by a current. The magnetic results obtained on sending the currents in different (relative) directions lead to a modification, M. Jamin thinks, of the theory of solenoids.

Studies on Diffraction; Geometric Methods for the Discussion of Problems of Diffraction.—M. Cornu.

Physiology of Flight of Birds.—M. Marey.—The author used various artificial birds for experiment. Comparing their wing-stroke with that of corresponding real birds he perceived that the former must be three or four times more rapid than the latter in order to raise the weight. Some condition, then, increasing the resistance of the air under the wing must be wanting in his apparatus. This is, he showed, the translation of the bird. Air shows inertia; that is, submitted to a constant repulsive force it resists strongly at first, then acquires velocity, which it tends to retain after the force has ceased to act. Move a light disc uniformly in a direction perpendicular to its plane. It may be shown with a registering dynanometer that there is—(1) A considerable resistance at the beginging, from inertia of the air column; (2) a weaker pressure maintained throughout the movement; (3) a tendency to impulsion of the disc when it has stopped, from the acquired velocity of the air column. Thus the resistance of the air to movements of bodies consists of a regular *regimé*, preceded and followed by two variable states. The former is that which various experimenters have sought to measure. The resistance of the air attaining its maximum during the initial variable state, it is clear that the wing of a bird would find in the air a more solid fulcrum if, throughout its descent, it were placed in these initial conditions. Now, through translation, the wing at each instant of its descent comes to act on a new column of air, which it tends to depress. But, from the short duration of the pressure, each of these columns has not time to acquire the velocity of the wing; it is thus compressed, and presents the maximum resistance of the initial variable state. To test this theory M. Marey gave his artificial birds a horizontal movement of translation: attaching one, *e.g.*, to the end of a long arm which was driven round while the wings were made to beat by means of a steam-driven air-pump. When the arm was stationary, the wing described between its extreme positions an angle of about 60°. On driving the arm 10 metres per second the amplitude was reduced to 30° and even 20°, showing the effect of resistance of the air on the velocity of the strokes.

On Transformation of a Vitroscope into a Tonometer, and its use for Determining the Absolute Number of Vibrations.—M. Terquem.—The author uses graduated tuning-forks with slides and a small lens (Lissajous). By moving the slides the rates of vibration can be varied throughout an octave. He has other tuning-forks with lenses, but ungraduated. One of the former, or standard forks, and one of the latter, or auxiliary forks, are fixed at right angles in the same horizontal plane, and may thus make horizontal and vertical vibrations respectively. Some powdered antimony is gummed to a branch of the auxiliary fork, and this, illuminated with a lamp, gives bright luminous points. The forks are first brought into unison, and then the variations of the elliptical curve (got from co-existence of the vibrations) when the slides are moved are noted, along with the number of beats in a given time. By a few further steps one is enabled to ascertain the absolute number of vibrations for each note.

Acoustic Pyrometer.—M. Chautard.—The author improves on Dr. Mayer's apparatus. Suppose a tuning-fork before a resonator connected with the two branches of the interference-apparatus of Quincke (as improved by Kœnig). From the movable branch a copper tube extends to the enclosure whose temperature is to be measured, and, returning on itself, communicates with a manometric capsule and jet. The fixed branch teminates in a second capsule, which is connected with the same burner. The jet is viewed in a rotating mirror, and the imaged forms vary with the temperature in a way the author describes.

Study on the Storms of the Year 1869.—M. Fron.

Third Memoir on Chemical Dynamics; the Intervention of Water in Chemical Combinations; Electrodes of Water and of other Liquids, and of their Properties.—M. Becquerel.—The author concludes from the facts detailed in this memoir that the method of experimentation employed to determine the electromoter force produced by the contact of two solutions by the employment of electrodes of water, or of other liquids, serves to compare the affinities of the substances in solution, separating the electric effects resulting from hydration from those springing from combinations, so that there is no longer any need of plunging electrodes of gold or platinum into the solutions, which sometimes attack the metal and introduce a source of error.

Heat Disengaged in the Combinations of Oxygen and Nitrogen.—M. Berthelot.—A lengthy paper. The author concludes that nitrous and nitric acids—leaving out of view the water which they contain—are produced with absorption of heat.

On Chloral and its Combination with Albumenoid Bodies.—M. J. Personne.—A controversial paper on the transformation of chloral into chloroform in the animal economy.

Test-Paper for Urea.—M. Musculus.—Urine, when it has arrived in full alkaline fermentation, is thrown upon a filter. The pores of the paper are soon filled up with globules of a certain ferment, and the filtration slackens. The paper is then washed with distilled water till the alkaline reaction has disappeared, and dried at a temperature of 35° to 40° C. In this state the paper is an efficient test for urea, which, if immersed even in a very dilute solution for ten or fifteen minutes, it converts into carbonate of ammonia. The test-paper should be coloured yellow with turmeric. It is then dried afresh, and preserved in a stoppered bottle. If a slip of the paper is soaked in a solution of urea containing only 1-10,000th part it soon becomes covered with brown spots. If it is required to detect urea in a liquid it must first be neutralised. If alkaline carbonates are present acid enough must be added to decompose the bicarbonates which may be formed. These salts might induce an error. They do not immediately colour turmeric paper brown, but after the lapse of a little time, the brown tint appears, especially on exposure to the air. Neutral alkaline salts do not interfere. The fermentation proceeds as well in the presence of phenic acid as in its absence. The quantitative determination of urea may be also performed with this paper. The solution is placed in a flask with some paper well saturated, and a little tincture of turmeric. Dilute sulphuric acid is added so as to produce the peculiar red (onion peel colour). The flask is stoppered and exposed to a temperature of 25° to 30° for five to six hours. The ammonia formed is then determined volumetrically, the standard acid being added until the red colour of the turmeric is reproduced. The best test-paper is obtained by filtering the white deposit from urine. The detection and determination of small quantities of urea in well waters supposed to be polluted by the drainage of cesspools may easily be performed with this paper. If no reaction is obtained the water may be concentrated.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 1, January 5, 1874.

At the meeting of the Society, December 5, 1873, M. Friedel made some observations on M. Claus's recent paper on the nature of Riboul's dichlorhydridic glycide.

M. Schutzenberger gave a preliminary notice on the respiratory phenomena of beer-yeast, and described the results he had obtained on bringing *Elodea Canadensis* in contact with a solution of cane-sugar. The saccharose is first inverted. A brisk butyric fermentation is then set up, hydrogen being disengaged, and the liquid becomes acid. If, after some time, the liquid is removed from the *Elodea* the butyric fermentation stops, and is soon replaced by an active alcoholic fermentation. At the same time an abundance of yeast globules appear, of which only slight traces were previously observed.

Phosphate of Cerium containing Fluorine.—M. F. Radominski.—The mineral in question is found in quantity at Kararfvet, near Fahlun in Sweden, and is considered in that country to be monazite. It contains phosphoric acid and oxides of cerium, lanthanum, and didymium; but it contains, also, notable amounts of fluorine and iron oxide, which is not the case with the monazites analysed by Kersten, Herrmann, and Damour. The mineral is found in large crystals of a chocolate-brown colour, and of the specific gravity 4·93. It is very imperfectly attacked by hydrochloric acid, but is completely unlocked by sulphuric acid and bisulphate of potassa.

On Tereben.—J. Ribau.—A claim of priority as against Orlowski.

Transformation of the Essence of Terebenthin and of Tereben into Cymen.—M. J. Ribau.—The author finds that terebenthin in the conditions necessary for its transformation into tereben is partially converted into cymen with disengagement of sulphurous acid, and that tereben treated with sulphuric acid, either hot or cold, is transformed into cymen with disengagement of sulphurous acid.

New Coloured Reactions of Phenate of Ammonia, in Connection with Erythrophenic Acid.—S. Cotton.—Whilst endeavouring (December, 1872) to transform phenic acid into aniline by means of ammoniacal salts, the author repeatedly observed a fine blue colouration. Suspecting oxidation, he was led to try the action of chlorine and of the hypochlorites upon a mixture of phenic acid and ammonia, and observed the following phenomena:—*Action of Alkaline Hypochlorites.*—(1) A mixture of phenic acid and ammonia takes a fine blue colouration in presence of alkaline hypochlorites. Air favours the development of the colour. (2) Phenic acid alone was treated with hypochlorite of lime, heat was applied to destroy the excess of hypochlorite, and ammonia was added to the mixture after it had cooled. No blue colouration. (3) Phenic acid was treated with hypochlorite of lime in the cold and in excess, and ammonia added. Blue colouration. (4) Dry hypochlorite was sprinkled with liquid phenic acid. Heat was disengaged, and the acid became brown. The mixture was placed in a saucer in the midst of a shallow layer of ammonia. Fine blue colouration. The alkaline hypochlorites behave in the same manner. The hypobromites give the same reaction, but much more distinctly and intensely. Ammonia may be replaced by one of its salts, provided always that the hypochlorite or hypobromite contains an excess of base capable of liberating the ammonia. When the hypochlorite acts upon a mixture of the two bodies, heat may be applied without injuring the development of the colour. *Action of Chlorine Water.*—(5) Phenic acid was treated with chlorine water and ammonia added in excess. No colour. (6) Phenic acid was dissolved in ammonia and chlorine water added drop by drop. Greenish colouration passing rapidly into blue. The blue colour is reddened by acids, and restored to its former shade by alkalies and alkaline carbonates. Bromine gives this reaction (No. 6) with more intensity and without any precautions. Iodine has no effect. On repeating the same experiments with the compound ammonias a splendid blue was obtained by treating a mixture of phenic acid and aniline with hypochlorites. The author had unsuccessfully attempted to apply this product in dyeing when in August M. Jacquemin laid before the Académie des Sciences researches on the same subject. He named the colouring matter erythrophenic acid. (7) A mixture of phenic acid and aniline was treated with chlorine water. Reddish colouration, turned to a blue by alkalies and alkaline carbonates. (8) Aniline, treated with chlorine water, gives the well known violet colouration. The excess of aniline was removed by filtration, and ammonia in excess was added to overcome the chlorine. The liquid turned brown; but on the addition of phenic acid, blue colouration. (9) Inversely, phenic acid was shaken up with chlorine water; after saturation with ammonia in excess aniline was added. No colouration. The hypochlorites yield corresponding reactions, and if they contain an excess of base, aniline may be replaced by its salts. Bromine and the hypobromites give nothing. No similar colourations were obtained by means of chromic acid. The colour derived from the phenate of ammonia has a close analogy with that from the phenate of aniline. The action of chlorine and the hypochlorites upon these two compounds may serve as a distinctive character for phenic acid, but not for aniline. Bromine and the hypobromites are very sensitive reagents for distinguishing phenate of ammonia from phenate of aniline.

New Colouring Matters.—E. Croissant and L. Bretonnière.—The authors have patented a process for converting organic bodies into true colouring matters. This process is applicable to a number of bodies, many of which are useless and worthless. They enumerate sawdust, humus from old trees, horn, starch, mosses, cellulose, tannin, aloes, &c. The principle employed is the dehydrogenation of the bodies by the action of sulphur at an elevated temperature, which the authors believe replaces the hydrogen. The process is very simple. If, *e.g.*, it is required to convert bran into colouring matter, it is placed in a small sheet-iron tank fitted with a lid. Caustic soda and flowers of sulphur are added in certain proportions, and the whole is made up into a homogeneous paste. The vessel is then placed in a furnace where it can be heated to 250° to 300°. Sulphuretted hydrogen is given off in abundance. When the mixture is dry, we find in the boiler, after cooling, a black friable matter, perfectly soluble in water, to which it imparts a fine sap-green. The solution has a strong affinity for fibres, which it dyes without mordant. One and the same body gives various tones of colour, according to the temperature and the proportions of the mixture. Certain substances, such as extracts of dyewoods, aloes, &c., are converted at boiling-point; whilst lignin, bran, &c., require a higher temperature. The following examples are added:—

(1)	Aloes	3 kilos.
	Caustic soda-lye at 40° B.	10 litres.
	Water	10 ,,
	Flowers of sulphur.. ..	3 kilos.

The mixture is boiled and yields a lilac-grey. At higher temperatures a deep brown is produced.

(2)	Humus	20 kilos.
	Normal sulphide	40 litres.

This "normal sulphide" contains 70 litres soda-lye at 40° B., 65 litres of water, and 30 kilos. of sulphur. To dye cotton, a sufficient quantity of the product is dissolved in water at 60° C., and the goods are worked in this in the usual manner. They are then passed through boiling bichromate of potash, which fixes the colour.

Mode of Employing Gum in Finishing Woven Fabrics.—M. Lafitte.—This paper is unintelligible, the kind of gum used not being mentioned.

Permanganates of the Alkaline Earths.—Tessié du Motay causes caustic baryta to react upon the manganates of potash or soda dissolved in water. Manganate of batyta is precipitated, and is afterwards decomposed with sulphuric acid. The free permanganic acid thus obtained serves for forming permanganates of lime and of magnesia.

Manufacture of Sulphuric Acid.—Martin, of Asnières, proposes to replace pyrites by artificial sulphide of iron, prepared by heating the following mixture:—

Sulphate of lime	1700
Peroxide of iron	1000
Charcoal	500

Neues Repertorium fur Pharmacie, Heft 11 and 12, 1873.

Most Recent Advances in Galvanoplastic, especially as Regards Iron.—Volger.

Collection of Resin in the Black Forest, Baden.—Flückiger.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 2, February, 1874.

New Process for the Manufacture of Beer so as to Render it Unalterable.—M. L. Pasteur.—This paper has been already noticed in the Chemical News.

NOTES AND QUERIES.

Nitrate of Amyl.—I am anxious to make a small quantity of nitrate of amyl. How must I proceed? I have some fusel oil.—R. I. T.

Coal Brasses.—(Reply to K.)—It is not necessary to mix coal brasses with the pyrites for the production of vitriol. The sulphuric acid is very brown indeed. The ordinary pyrites burner will answer with a little management.—R. I. T.

Linseed Oil.—(Reply to F. P. C.)—There is no means known of perfectly separating cotton-seed oil from linseed oil. I shall be happy to supply you with some pure linseed oil if you send me your address.—F. R. G.

MEETINGS FOR THE WEEK.

Monday, March 9.—Medical, 8. Anniversary.
— London Institution, 4.
Tuesday, 10.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
— Civil Engineers, 8.
— Anthropological, 8.
— Photographic, 8.
— Deaf and Dumb Association, 272, Oxford Street, Public Lecture, 8. Mr. Chas. W. Vincent, F.C.S., "On the Beginnings of Electrical Research;" interpreted by the Rev. A. Smith.
Wednesday, 11.—Society of Arts, 8.
— London Institution, 7.
— Geological, 8.
Thursday, 12.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation (Ferns and Mosses)."
— Royal, 8.30.
— Royal Society Club, 6.
Friday, 13.—Royal Institution, 8; Weekly Evening Meeting. Dr. C. R. A. Wright, "On the Chemical Changes Accompanying the Smelting of Iron in Blast-Furnaces," 9.
— Astronomical, 8.
— Quekett Microscopical Club, 8.
Saturday, 14.—Royal Institution, 3. Mr. C. F. Newton, Keeper of Greek and Roman Antiquities, British Museum, "On Ephesus."

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THE CHEMICAL NEWS.

Vol. XXIX. No. 746.

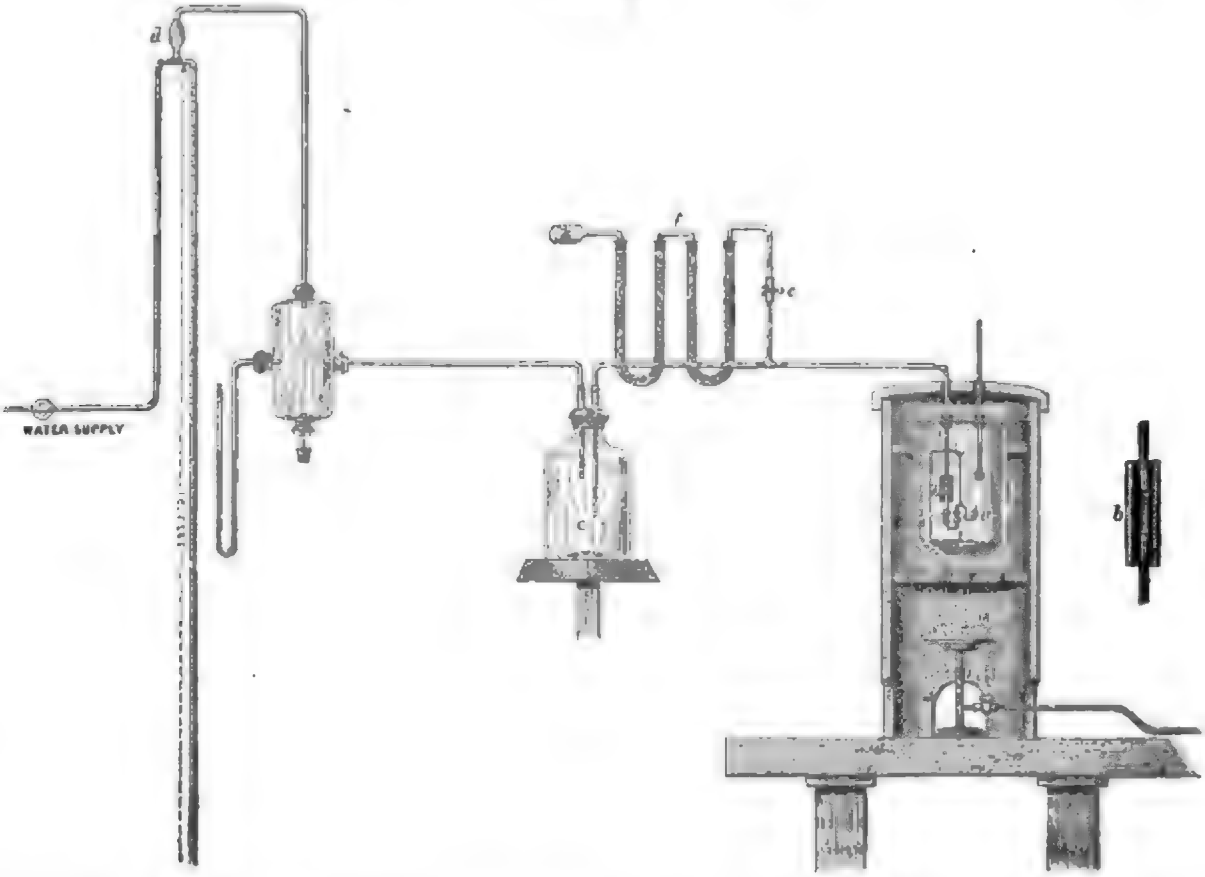
RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 105).

The data for ascertaining the weight of the apparatus and the thallium it contains have now been obtained. The next operation is to convert the thallium into nitrate. For this purpose, the tube *g* (Fig. 17) must be opened; and to effect this without any risk of losing particles of glass, I gently warm the extremity in a spirit-lamp, and then apply the tip of a blowpipe-flame to the warm glass at *g*. The atmospheric pressure outside, acting against the vacuum inside, immediately perforates a small hole through the glass, into which the air rushes.

Fig. 19.



Some nitric acid, purified in the manner described, is now removed from the bulb in which it has remained sealed up, and a little is introduced into the bulbs *h* and the globe *b*; this is readily effected by alternately warming and cooling *b*, the perforation *g* dipping under the acid. Sufficient nitric acid must be introduced to three-quarters fill the two lower bulbs and also to moisten the thallium in the globe *b*. The apparatus is then placed in a horizontal position, and the quantity of acid in the bulbs is regulated so as to allow air-bubbles to pass in either direction and be washed without spirting acid out.

No reaction, or scarcely any, between strong nitric acid and thallium takes place in the cold; but on applying gentle heat the metal is attacked, and becomes rapidly converted into nitrate. The quantity of acid which is allowed to act at a time must be very limited, and the temperature should not be higher than is sufficient to prevent the nitrate of thallium formed crystallising on the metal and interfering too much with the action. As soon as the action ceases, a little nitric acid from the washing-bulbs is allowed to run into the globe, its place being supplied with fresh acid. When cold, the crystallisation of the nitrate of thallium entirely prevents the reaction between the metal and acid, but, on warming, the salt dissolves and the action proceeds. The vapours of nitric and nitrous oxide, which are evolved in abundance, are washed by passing through the system of bulbs, and the reaction must be only just sufficient to cause them to pass through slowly.

In course of time the whole of the thallium is dissolved, and the most tedious part of the process then commences—the evaporation of the excess of free acid.

For this purpose an apparatus is used represented in Fig. 19. *a* is the apparatus connected by a wide tube, *b*, and a narrower glass tube with a bottle, *c*. This is in connection with a Bunsen's water-pump, *d*, having 18 feet fall of water, and capable of producing an exhaustion equal to 10 inches of mercury. The water is supplied to this pump by an independent pipe and tap attached to a large cistern, so that it can be allowed to work continuously day and night without interfering with the ordinary water-supply of the laboratory. The apparatus *a* is enclosed in a glass case, and stands in an air-bath, the temperature of which can be kept constant by means of a gas-regulator. The water of the pump being set in motion, and a temperature of about 250° F. being maintained in the air-bath, evaporation of the nitric acid commences, the vapour partly condensing in the bottle *c*, and partly being carried away through the pump. As the evaporation of the acid proceeds, the temperature is gradually raised, until ultimately it becomes as high as 380° F., which must not be exceeded in this stage of the operation. In course of time (varying from a few days to as many weeks according to the quantity of acid to be drawn off, and the size of the perforation through which it is to pass) the nitrate of thallium is left in the form of dry white crystals.

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* A Paper read before the Royal Society June 20, 1872.

The pump is then stopped, and air allowed to enter the apparatus by opening the pinchcock, *e*, connected with the chloride-of-calcium tubes, *f*. The apparatus being cooled, water is added to the nitrate of thallium in the proportion of bulk for bulk, about 1 grain of oxalic acid[*] being dissolved in the water. Heat is then applied, and the solution boiled until all the nitrate of thallium is dissolved, forming a clear, colourless liquid, which deposits, on cooling, brilliantly-white crystals of nitrate of thallium.[†]

The nitric acid having been previously removed from the bottle *c* and the rest of the tubes, the apparatus is again fitted to the pump. It is heated in the air-bath, and the water gradually drawn out under diminished pressure, the temperature being kept a little below the point of ebullition of the liquid. When apparently dry, the heat is very carefully raised to 394° F., at which temperature the crystals of nitrate of thallium melt; a little froth at first breaks the surface, but this soon disappears, and the liquid becomes as clear and colourless as water. If sufficient oxalic acid has been added to decompose the pernitrate of thallium, no deposit whatever is visible in the liquid; but should any be seen, a fraction of a grain of oxalic acid must be added with the water in the next operation.

As soon as the nitrate is in the form of a clear liquid, the apparatus is allowed to cool,[‡] and after being disconnected from the pump is weighed in the air-balance, no particular precautions being taken, however, and the air having free access to the interior of the apparatus.

Water is again added, the nitrate of thallium is dissolved and allowed to crystallise out, and the operation of evaporating the water under diminished pressure in the air-bath is repeated exactly as already described.

The dry nitrate is again fused at 394° F., and, after the whole apparatus is heated to about 420° F. for a few minutes, it is allowed to cool, and is again weighed. If there has been loss of weight, the operation must be repeated till the weights are constant.

When this is the case, the apparatus must be disconnected from the Bunsen water-pump, and attached by its extremity *g*, Fig. 17, to the Sprengel mercury-pump. The air is now exhausted as perfectly as possible, and, when quite vacuous, the tube is sealed up at *i* (Fig. 17) by the application of a small spirit-flame. Care must be taken in doing this to lose no particle of glass, as the end of the tube *g* which is drawn off, having been included in the first weighing, must be carefully preserved and weighed along with the apparatus in all the subsequent weighings.

The apparatus is now of the form shown in Fig. 18. It contains nothing but the pure nitrate of thallium produced from the action of nitric acid on the thallium at first introduced, and is entirely free from air. It is now, with the loose piece of tube *g* belonging to it, to be weighed in the vacuum-balance at two different atmospheric pressures, with all the precautions already adopted in the previous weighings.

When the data for ascertaining the weight of the glass apparatus and the nitrate of thallium are correctly obtained, the weight of the glass apparatus by itself has to be taken.

For this purpose a hole is perforated in the tube *i*, as before described, by means of a blowpipe-flame, and, water being introduced, the nitrate of thallium is dissolved out, and by repeated washings ultimately removed. The completion of the operation is ascertained by evaporating some of the washing water almost to dryness, and testing by means of the spectroscope. The apparatus is then dried, connected with the Sprengel pump, and after complete exhaustion it is sealed up at *h*, the same precautions being taken to preserve the piece of tube now removed as were adopted in the previous sealing up.

The empty apparatus is now to be weighed at different atmospheric pressures in the vacuum-balance with all necessary precautions, the two loose pieces of glass tube *g* and *i h* being now included, and, from the data thus obtained, its true weight is calculated. There have thus been obtained:—

α. The weight of the glass + thallium.
β. The weight of the glass + nitrate of thallium.
γ. The weight of the glass alone.

From these data, the atomic weight of thallium can be calculated by the formulæ given in the next section.

(To be continued.)

NOTE ON PHOSPHORUS SULPHOBROMIDE.

By R. W. EMERSON MACIVOR.

This compound, the sulphur analogue of phosphoryl tribromide, was first prepared by Baudrimont, who obtained it by transmitting a current of dry hydrogen monosulphide through phosphorus pentabromide, when the following reaction takes place:—

$$P^{v}Br_5 + H_2S = P^{v}Br_3S + 2HBr.$$

The product of this reaction, however, is always mixed with more or less undecomposed pentabromide, which may be removed by washing the impure substance with water heated to a temperature of about 40° C. By this process of washing, the pentabromide is decomposed into phosphoric and hydrobromic acids, together with a small quantity of the sulphobromide. The purified substance is next pressed between the folds of bibulous paper, and finally placed in an exsiccator over strong sulphuric acid, and allowed to remain there until the last traces of adhering water have been removed.

Phosphorus sulphobromide is at ordinary temperatures a yellowish, crystalline, solid substance, possessed of an aromatic, but very pungent odour, and fusing at 36·4° C. When it has been melted and allowed to cool in a still place, it frequently remains in the liquid condition for weeks; but if the vessel containing it be shaken, or a granular body be dropped into the liquid, crystallisation immediately sets in, and in a short time the whole mass is solid. It is soluble in carbon disulphide, and its solution in this menstruum, if allowed to evaporate, deposits the compound crystallised in octahedra, which have a sp. gr. of 2·87. It is also dissolved by ether. It is slowly, but completely, decomposed by water, the products of the action being hydrogen monosulphide, sulphur, hydrobromic, phosphorous and phosphoric acids.

Glasgow, February 23, 1874.

VALVE FOR GASES AND CORROSIVE FLUIDS.

By ROLAND H. RIDOUT.

Requiring some time ago to force fluids into vessels under pressure, I found that usually a small quantity was driven back. The following valve suggested itself:—A piece of glass tube, about 3″ long and 3-16ths of an inch internal diameter, has a bulb blown in the middle, the ends being cut off square, and the edges rounded by holding in the blowpipe flame.

A piece of india-rubber tube 3″ long, and of such thickness that it will just pass into the bulb-tube. One end of this is tied, either with string or a fine platinum wire. A short distance below the ligature a transverse slit is made with sharp scissors, so that the end is nearly cut off. The uncut part serves as a hinge. Any pressure along the tube will raise the end upon the hinge formed; but when the pressure ceases the slit will be closed, and any further back pressure will only tend to make the junction more complete. The cut edges must be slightly greased, to prevent their cohesion. This tube is then stretched on a piece of glass tube, so that it will with difficulty enter the bulb-tube. The valve-slit should extend to about 1-10th of an inch beyond the glass tube, and then the whole, being greased, is forced into the bulb-tube, till the valve occupies the interior of the bulb and has plenty of room to work. A small pellet of cork or india-rubber is placed in the part beyond the slit, otherwise the pressure would cause it to collapse, and so be rendered useless. I have had no opportunity of testing this valve with pressures greater than 30 lbs. per square inch, but up to this point it is perfectly air-tight. The time one takes to make is about twenty minutes.

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[*] If the action of nitric acid on thallium is allowed to become too violent, or if the nitrate of thallium is long heated with excess of nitric acid, a little pernitrate of thallium is formed, which, on subsequent fusion of the nitrate, deposits a brown powder of peroxide of thallium. The oxalic acid is therefore added to decompose the pernitrate of thallium. The excess of oxalic acid disappears with the last traces of free nitric acid and water.

[†] Nitrate of thallium is soluble in 9·4 times its weight of water at 60° F., and in less than one-fourth of its bulk of boiling water. The crystals deposited on cooling are anhydrous.

[‡] If a considerable bulk of fused nitrate of thallium is allowed to solidify in a thin bulb, the glass is almost certain to crack, owing to unequal contraction. Many of my operations were spoilt by this cause. By keeping the apparatus in motion during solidification, so as to allow the nitrate to line the greater part of the inner surface of the bulb, this source of danger is avoided.

Monmouth, Feb. 18, 1874.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 5, 1874.

Professor G. C. Foster, F.R.S., in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. W. H. Pike, J. G. Lyon, and Magnus Ohren were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. J. A. Fleming, Henry Critchett Bartlett, A. J. Greenaway, Mackay Heriot, William Cunningham, George Henry Beckett, and George Smith. For the third time—Messrs. George Chaloner, Thomas Charles, M.D., Henry Leicester Greville, A. S. Napier, B.Sc., Saranoski M. Nishigaiva, John Linford, James T. Armstrong, Harry Edgecumbe Thomas, and F. V. L. Cruse, who were balloted for, and duly elected.

The Chairman then announced the proposed changes in the Officers and Council of the Society. The Vice-Presidents retiring are Dr. Debus and Dr. Stenhouse, in place of whom it is proposed to elect Dr. Gladstone and Dr. Longstaff. The other Members of Council are Messrs. J. Attfield, J. Dewar, R. Warington, and C. R. A. Wright, in place of Messrs. A. Crum-Brown, E. Divers, B. F. Duppa, and H. McLeod.

The first paper, "*On the Spontaneous Combustibility of Charcoal*," by Mr. A. F. Hargreaves, was read by the author. He first noticed the best kinds of wood, and the best method of carbonising them so as to give a charcoal most suitable for the manufacture of gunpowder. The preference is given to black dogwood (*Rhamnus frangula*), which is charred in iron cylinders, the combustible gases evolved from one set being employed to heat the adjoining set: by this means the amount of coal required is greatly diminished. The charcoal produced is generally about 20 per cent of the wood. The temperature at which the operation takes place is very important, as at a low temperature the carbon is too hygroscopic, whilst at a very high temperature it does not burn with sufficient rapidity, and consequently the gunpowder made from it gives a comparatively low velocity. When taken from the cylinders, the charcoal is placed in iron coolers provided with tightly-fitting lids, and allowed to stand for twenty-four hours before it is put into the store-bins. If the charcoal is ground twenty-four hours after burning, and is placed in large iron coolers with the lids off, the temperature gradually rises, and in less than thirty-six hours afterwards, it takes fire. If ground, however, after an interval of three days, there is no perceptible rise of temperature. From a series of experiments which the author made, it would appear that charcoal continues to absorb oxygen for thirty-six hours after it has been burnt, and the full amount of hygroscopic moisture is only attained after exposure to the air for about two weeks.

Two papers entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies (Part V., On the Bromides of the Olefines; Part VI., On Ethyl Bromide)*," by J. H. Gladstone, F.R.S., and A. Tribe, F.C.S., were read by the former. The dry couple has but little action on ethylen bromide even at its boiling-point, the products being ethylen and zinc bromide. In the presence of water, however, the bromide is decomposed readily at the ordinary temperature; zinc alone acts but slowly—the reaction in both cases being $C_2H_4Br_2+Zn=C_2H_4+ZnBr_2$. In the presence of alcohol, the couple acts so violently that it was found necessary to substitute zinc-foil. In this case no action takes place for half an hour, but it then proceeds rapidly, and is terminated in twenty-four minutes. As the nature of the reaction is the same whether the dry couple is used or whether it is moistened with water or alcohol, it was thought that the difference in the rapidity of the action might be due to the insolubility of the zinc bromide in ethylen bromide. The action of ethylen bromide diluted with twice its bulk of ether was therefore tried, but it was much more sluggish than with water or with alcohol, so that it would seem that the nature of the solvent exerts an influence on the reaction. A detailed account of the experiments made with propylen bromide and amylen bromide was also given, the results being analogous to those obtained with ethylen bromide, the bromide of the olefine yielding the olefine and zinc bromide—

$$C_3H_6Br_2+Zn=ZnBr_2+C_3H_6,$$
$$\text{and } C_5H_{10}Br_2+Zn=ZnBr_2+C_5H_{10}.$$

The authors were anxious to investigate the action of the couple on ethyl bromide in order to ascertain whether a zinc ethylobromide and brom-ethylate could be obtained, and also as to whether it would not afford an economical method for the preparation of zinc ethyl. They find that the action between the dry couple and the bromide varies greatly in different experiments, and appears to depend on small differences in the conditions, the nature of which they have not been able satisfactorily to determine. They succeeded, however, in obtaining zinc ethylobromide—

$$\left.\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn$$

by this means, as also by the direct union of zinc ethyl with zinc bromide. It melts at 62° C., and crystallises on cooling in white pearly scales; when heated it yields zinc ethyl. In some of the experiments no action took place, even when the ethyl bromide was heated with the dry couple for thirty-six hours. When the ethyl bromide is mixed with a little ethyl iodide, the reaction always takes place, and with comparative rapidity, the ethiodide at first formed appearing to facilitate the formation of the ethylobromide. On heating the product, however, only one-third of the zinc ethyl passes over which is theoretically obtainable, probably owing to the comparatively high temperature at which it is decomposed. The reactions which then take place simultaneously may be thus represented—

$$2\left\{\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn=ZnBr_2+Zn+C_2H_6+C_2H_4.$$
$$2\left\{\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn=ZnBr_2+\left\{\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}Zn.$$

The action of the couple on ethyl bromide in the presence of water or alcohol is very slow at the ordinary temperature, but proceeds much more rapidly when heated, ethyl hydride being evolved. The reaction with alcohol is—

$$\left.\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn+\left\{\begin{matrix}C_2H_5\\H\end{matrix}\right\}O=\left\{\begin{matrix}C_2H_5O\\Br\end{matrix}\right\}Zn+C_2H_6,$$

a zinc brom-ethylate being produced analogous to the zinc iodo-ethylate. With water the reaction is—

$$\left.\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn + H_2O = \left\{\begin{matrix}HO\\Br\end{matrix}\right\}Zn + C_2H_6.$$

Professor Foster having thanked the authors in the name of the Society, a paper entitled "*Researches on the Preparation of Organo-Metallic Bodies of the C_nH_{2n} Series of Hydrocarbons*," by Dr. D. Tommasi, was read by the Secretary. The author, after remarking that the existence of diatomic organo-metallic bodies is possible if the zinc methyl, zinc ethyl, &c., are compounds of the monatomic radicals with metals, said that, although the attempts to obtain zinc ethylen by means of ethylen bromide have failed hitherto, yet he hopes to be more successful by varying the conditions of experiment, or by substituting ethylen iodide for the bromide. He finds that zinc readily attacks a solution of ethylen bromide in common alcohol at the ordinary temperature, with evolution of a gas which proved to be ethylen. The alcoholic solution contains zinc bromide and a small quantity of a compound which is decomposed by water with liberation of zinc oxide. Zinc, however, has no action in the cold on a mixture of the bromide with absolute alcohol. Ethylen bromide, in presence of amylic alcohol or ethylic acetate, is decomposed by zinc at the ordinary temperature; with an ethereal solution an action takes place at 100° C., but with chloroform there is no action even after several days' heating. Contrary to his expectations, the author found that magnesium had no action on mixtures of ethylen bromide with alcohol, amylic alcohol, ethyl acetate, or ether, either at the ordinary or at a higher temperature. An alloy of zinc very rich in sodium slowly attacks an alcoholic solution of ethylen bromide.

After the author had been thanked by the Chairman in the name of the Society, the Secretary read a "*Note on the Action of Trichloracetyl Chloride on Urea*, by Messrs. R. Meldola and D. Tommasi. On digesting urea with four times its weight of the chloride for about twenty minutes, the mixture begins to solidify. The heating is continued until the hydrochloric acid and the excess of trichloracetyl chloride are expelled, and the product is then crystallised from alcohol. Trichloracetyl urea—

$$CO\left\{\begin{matrix}NH(C_2Cl_3O)\\NH_2\end{matrix}\right.$$

forms tufts of white silky needles, which are readily soluble in warm water, but are decomposed on boiling the solution with formation of an acid, the barium salt of which crystallises in square prisms. The urea melts at 150° C. with partial decomposition. It is also decomposed by boiling with a solution of sodium hydrate, or by digestion with alcoholic ammonia at 100°. With silver oxide it yields silver chloride and a soluble silver salt.

The last paper, on "*The Agglomeration of Finely-Divided Metals by Hydrogen*," was read by the author, Mr. A. Tribe. During an examination into the nature of the black deposit produced by the action of a dilute solution of copper sulphate on metallic zinc, the author thought that the difficulty of burnishing the finely-divided copper was due to the presence of oxide. Accordingly he treated some of it with acetic acid, when immediately the granular particles of which it consists agglomerated, with an apparent increase of bulk, to a grey sponge-like mass, which assumed a metallic appearance under the burnisher. Dilute hydrochloric acid or sulphuric acid produces a similar effect. After numerous experiments made with a view of ascertaining the cause of this phenomenon, the author ascertained that it was due to the action of hydrogen on the finely-divided metal. A similar effect is produced with palladium or platinum black. The explanation which the author suggests is that the minute metallic particles, by virtue of a species of adhesive attraction, become surrounded by films or layers of liquid hydrogen, the coalescence, or partial coalescence, of which produces the spontaneous inward movement of the finely-divided metal which is characteristic of agglomeration.

At the conclusion of the paper, the meeting was adjourned until Thursday, March 19, when there will be a lecture "On Dissociation," by Prof. J. Dewar.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 27th, 1874.

Rev. William Gaskell, M.A., Vice-President, in the Chair.

"*On the Effect of Acid on the Interior of Iron Wire*," by Professor Osborne Reynolds, M.A.

It will be remembered that at a previous meeting of this Society Mr. Johnson exhibited some iron and steel wire in which he had observed some very singular effects produced by the action of sulphuric acid. In the first place the nature of the wire was changed in a marked manner, for although it was soft charcoal wire it had become short and brittle; the weight of the wire was increased; and what was the most remarkable effect of all was that, when the wire was broken and the face of the fracture wetted with the mouth, it frothed up as if the water acted as a powerful acid. These effects, however, all passed off if the wire were allowed to remain exposed to the air for some days, and if it were warmed before the fire they passed off in a few hours.

By Mr. Johnson's permission, I took possession of one of these pieces of wire and subjected it to a further examination, and from the result of that examination I was led to what appears to me to be a complete explanation of the phenomena.

I observed that when I broke a short piece from the end of the wire the two faces of the fracture behaved very differently—that on the long piece frothed when wetted, and continued to do so for some seconds, while that on the short piece would hardly show any signs of froth at all. This seemed to imply that the gas which caused the froth came from a considerable depth below the surface of the wire, and was not generated on the freshly-exposed face. This view was confirmed when, on substituting oil for water, I found the froth just the same.

These observations led me to conclude that the effect was due to hydrogen, and not to acid, as Mr. Johnson appeared to think, having entered into combination with the iron during its immersion in the acid, which hydrogen gradually passed off when the iron was exposed.

It was obvious, however, that this conclusion was capable of being further tested. It was clearly possible to ascertain whether or not the gas was hydrogen; and whether hydrogen penetrated iron when under the action of acid. With a view to do this I made the following experiments.

First, however, I would mention that after twenty-four hours I examined what remained of the wire, when I found that all appearance of frothing had vanished, and the wire had recovered its ductility, so much so that it would now bend backwards and forwards two or three times without breaking, whereas on the previous evening a single bend had sufficed to break it.

I then obtained a piece of wrought-iron gas-pipe 6 inches long and $\frac{5}{8}$ inch external diameter, and rather more than $\frac{1}{16}$ of an inch thick; I had this cleaned in a lathe, both inside and outside; over one end I soldered a piece of copper, so as to stop it, and the other I connected with a piece of glass tube by means of india-rubber tube. I then filled both the glass and iron tubes with olive oil, and immersed the iron tube in diluted sulphuric acid which had been mixed for some time and was cold. Under this arrangement, any hydrogen which came from the inside of the glass tube must have passed through the iron.

After the iron had been in the acid about five minutes small bubbles began to pass up the glass tube. These were caught at the top, and were subsequently burnt and proved to be hydrogen. At first, however, they came off but very slowly, and it was several hours before I had collected enough to burn. With a view to increase the speed, I changed the acid several times without much effect until I happened to use some acid which had only just been diluted and was warm; then the gas came off twenty or thirty times as fast as it had previously done. I then put a lamp under the bath, and measured the rate at which the gas came off, and I found that when the acid was on the point of boiling as much hydrogen was given off in five seconds as had previously come off in ten minutes, and the rate was maintained in both cases for several hours.

After having been in acid for some time the tube was taken out, well washed with cold water and soap, so as to remove all trace of the acid; it was then plunged into a bath of hot water, upon which gas came off so rapidly from both the outside and inside of the tube as to give the appearance of the action of strong acid. This action lasted for some time but gradually diminished. It could be stopped at any time by the substitution of cold water in place of the hot, and it was renewed again after several hours by again putting the tube in hot water. The volume of hydrogen which was thus given off by the tube after it had been taken out of hot acid was about equal to the volume of the iron.

At the time I made these experiments I was not aware that there had been any previous experiments on the subject; but I subsequently found, on referring to Watts's "Dictionary of Chemistry," that Cailletet had in 1868 discovered that hydrogen would pass into an iron vessel immersed in sulphuric acid. (See *Comptes Rendus*, vol. lxvi., p. 847.)

The facts thus established appear to afford a complete explanation of the effects observed by Mr. Johnson.

In the first place, with regard to the temporary character of the effect, it appears that hydrogen leaves the iron slowly even at ordinary temperatures—so much so that after two or three days' exposure I found no hydrogen given off when the tube was immersed in hot water. With regard to the effect of warming the wire—at the temperature of boiling the hydrogen passed off 120 times as fast as at the temperature of 60°. Also when the saturated iron was plunged into warm water the gas passed off as if the iron had been plunged into strong acid; so that we can easily understand how the hydrogen would pass off from the wire quickly when warm, although it would take long to do so at the ordinary temperatures. With regard to the frothing of the wire when broken and wetted, this was not due, as at first sight it appeared to be, simply to the exposure of the interior of the wire, but was due to warmth caused in the wire by the act of breaking. This was proved by the fact that the froth appeared on the sides of the wire in the immediate neighbourhood of the fracture, when these were wetted, as well as the end; and by simply bending the wire it could be made to froth at the point where it was bent.

As to the effect on the nature and strength of the iron I cannot add anything to what Mr. Johnson has already observed. The question, however, appears to be one of very considerable importance, both philosophically and in connection with the use of iron in the construction of ships and boilers. If, as is probable, the saturation of iron with hydrogen takes place whenever oxidation goes on in water, then the iron of boilers and ships may at times be changed in character and rendered brittle in the same manner as Mr. Johnson's wire, and this, whether it can be prevented or not, is at least an important point to know, and would repay a further investigation of the subject.

Mr. **Carson** desires to correct a statement which appears in a notice read at the meeting on January 13th last, "On a Crystalline Sublimed Cupric Chloride," in which, through a misunderstanding, he stated that sodium chloride was volatilised in Deacon's chlorine process when sodium sulphate is added to the copper salt. He since has learnt from Mr. Deacon that no such volatilisation of sodium chloride has been observed.

AMERICAN SOCIETY OF CIVIL ENGINEERS

December 9th, 1873.

"*Note relating to Rumford's Determination of the Mechanical Equivalent of Heat,*" by Prof. **Robert H. Thurston**, Member of the Society.

In his "Sketch of Thermodynamics,"[*] Prof. Tait gives (p. 44, § 78) a *resumé* of the history of the growth of that science, and presents the following as the order of its development:—

First.—Newton's grand general statement of the laws of transference of mechanical energy from one body or system to another (1687).

Second.—Davy's proof that heat is a form of energy subject to these laws (1799).

Third.—Rumford's close approximation to a measure of the mechanical equivalent (1798).

Fourth.—Fourier's great work on one form of dissipation of energy (1812).

Fifth.—Carnot's fundamental principles, his cycles of operation, and his tests of a perfect engine (1824).

Sixth.—Thomson's introduction of an absolute thermodynamic scale of thermometry (1848).

Seventh.—Joule's exact determination of the mechanical equivalent of heat, and the general reception of the true theory in consequence of his experiments (1843-9).

Eighth.—The adaptation, by Clausius and Rankine, and subsequently, with greater generality and freedom from hypothesis, by Thomson, of mathematical investigation (partly based on Carnot's methods) to the true theory; the re-establishment of the great second law by Clausius, with Joule's experimental verification of Thomson's general results (1849-51).

Ninth.—Thomson's theory of dissipation (1852).

Here, as elsewhere, the author of the above *resumé* states fairly the work done by Rumford, but here, as elsewhere, he places his services second in importance to those of Davy, as well as in their actual influence upon the growth of the science of thermodynamics, and does not, apparently, consider them comparable to those of Joule.

In an earlier portion of the work (pp. 7—9, §§ 13—15), the work of Rumford is correctly described, and a value of the mechanical equivalent is deduced and stated at 940 foot-pounds, the estimate being based on the assumption of 30,000 foot-pounds per minute as the true value of a horse-power. The experiment of Rumford consisted in the measurement of the heat developed by the power employed in boring cannon at the Arsenal, in Munich, and his paper describing the method and giving its results was published in the *Philosophical Transactions of the Royal Society of London* for the year 1798.

After showing that the heat evolved through the agency of friction could not have been derived from any surrounding objects, or by compression of the materials employed or acted upon, he says—"It appears to me to be extremely difficult, if not impossible, to form any distinct idea of anything capable of being excited and communicated in the manner that heat was excited and communicated in these experiments, except it be motion,"[†] and then goes on to urge a zealous and persistent investigation of the laws governing this motion. Estimating the quantity of heat evolved by a power which, as he states, could easily be exerted by one horse, he makes it equal to the "combustion of nine wax candles, each ¾ of an inch in diameter."[‡] This heat he also states as equivalent to the elevation of "26·58 pounds of ice-cold water" to the boiling-point,[‖] or 4784·4 thermal units, and the time occupied "one hundred and fifty minutes."

The "horse-power" used by engineers as a unit of power-measurement is 33,000 foot-pounds per minute, but this figure, which was taken by Watt, originally, to represent the "average work of the strongest London draught-horses,"* is much too high for application in estimation of animal power. It is well known among engineers that two-thirds this figure is a more correct value. Rankine† gives for the average draught-horse 25,920 foot-pounds per minute, or 432 per second, and this value, correct as it probably is for Great Britain, is certainly too high for Bavaria. If the horse-power of Rumford be taken at 25,000 foot-pounds per minute—a value far more likely to be correct than 30,000, as assumed in "Sketches of Thermodynamics"—the mechanical equivalent, as deduced from Rumford's experiment, becomes 783·8, differing by only 1·5 per cent from the value now accepted as determined by Joule a half century later, which is nearer the probably correct value than the result of any other investigation, and is even far more accurate than many results obtained by Joule himself.

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[*] "Sketch of Thermodynamics," by P. G. Tait, M.A., Edinburgh 1869.

[†] *Abridged Phil. Trans.*, vol. xviii., p. 286.

[‡] *Ibid.*, p. 284

[‖] *Ibid.*, p. 283.

Could Rumford have eliminated loss due to evaporation, radiation, and conduction, of which loss he was well aware, and to the influence to which he refers, it is very certain that he would have given us a more precise determination of this quantity than even that which is above deduced.

We may then claim for Rumford—

First.—That he was the first to prove the immateriality of heat, and to indicate that it is a form of energy, publishing his conclusions a year before Davy.

Second.—That he first, and nearly a half century before Joule, determined, with almost perfect accuracy, the mechanical equivalent of heat.

Third.—That he is entitled to the sole credit of the experimental discovery of the true nature of heat.

The "second" and "third" of the *resumé* quoted should, therefore, be transposed, even if the work of Sir Humphry Davy should not be deemed simply the supplement of earlier labour and merely corroboratory.

Benjamin Thompson, of Concord, New Hampshire, commonly known as Count Rumford, should be accorded a nobler position and a higher distinction than he has yet been given by writers on thermodynamics.

CORRESPONDENCE.

UNSCIENTIFIC REVIEWERS: PINK AND WEBSTER'S "ANALYTICAL CHEMISTRY."

To the Editor of the Chemical News.

Sir,—My attention has just been directed to a letter signed A. G. P., Chemical News, vol. xxix., p. 90, and I shall feel greatly obliged if you will kindly insert this in reply.

The first so-called extract that A. G. P. brings before our notice is as follows:—"The solution of this salt must be neutral after precipitation *of* SO_2HO_2, sulphuric acid" (referring to baric chloride). Here are two misrepresentations; the formula of sulphuric acid being in "Analytical Chemistry" SO_2Ho_2, and not SO_2HO_2; the second *of* in the sentence is in reality *by*. When these corrections are inserted, A. G. P. will be instructed by referring to Galloway's "Manual of Qualitative Analysis," page 406, p. 37; also to "Qualitative Analysis," by Fresenius, page 64, § 58.

In the next attempted extract A. G. P. is again at variance with "Analytical Chemistry;" there is no such formula as $CONaO_2$ given for sodic carbonate.

In the next paragraph A. G. P. gives some specimens of what he calls "lucid English," with which he says the work abounds, as follows:—"p. 121, '*Manufacture* of Oxygen'—A little MnO_2, manganic oxide, or Fe_2O_3 (peroxide, sesquioxide, or red oxide of iron) added, reduces the heat required for the giving off of the oxygen, but is liable to contaminate it by traces of Fe or Mn, and from potassic *chloride*."

In looking over this it would be the impression that in "Analytical Chemistry" the paragraph was headed *Manufacture* of Oxygen, but if your readers will refer to the work in question they will perceive that *Manufacture* is only the *lucid English* of A. G. P.; also chloride has been given for chlorate, and the word *the* omitted. A. G. P. continues—"The conclusion of this sentence seems unintelligible," with which I quite agree, as A. G. P.'s insertions simply read ridiculous.

With regard to his remarks respecting measuring-flasks, it might be well for your readers to refer to "Analytical Chemistry." It has been suggested to me that "Perhaps A. G. P. has never seen one!"

In the next remarks we have again a misrepresentation, as follows:—"Anyone who has seen the pulverulent condition of copper deposited from solution by the action of iron will appreciate the difficulty attending the process of rolling into sheets." If your readers refer to "Analytical Chemistry" they will find that it does *not* propose to precipitate the copper by iron; and it will instruct A. G. P. to obtain "Metallurgy of Copper," in the Weale series, so that he may read the "Electro-metallurgy" on page 221, and then contrast that with "Chemistry," by C. L. Bloxam, page 338, end of paragraph 237.

We now come to the quantitative portion, in which A. G. P. makes the complaint that it is "pre-supposed that the operator has a solution of the substance to be estimated entirely free from other salts." If, in preparing the work, it had been intended for those who where ignorant of the formulæ of sulphuric acid, sodic carbonate, or the difference between a chloride and a chlorate, the usual course adopted by modern writers on quantitative analysis might have been departed from with advantage, but considering the present general state of scientific knowledge it was thought better to follow the usual course.

In the same paragraph we have the following:—"The most frequent, and indeed almost universal, method of estimation appears to be—'*Add sulphuric acid, evaporate to dryness, and ignite.*'" This is a great misrepresentation as the expression never occurs once. Can such an error have made by mistake?

I shall not trouble your readers with going into the three remaining remarks A. G. P. has thought right to make, as they are of the same description as those already considered.

In conclusion, and in answer to the question of A. G. P. as to what the probable result would be of a student's efforts in pursuit of knowledge were he to "practically follow the course as laid down," I would strongly suggest that it would instruct him with regard to the simple formulæ, and give him a love of truth.—I am, &c.,

G. E. Webster.

Nottingham, March 3, 1874.

ESTIMATION OF CARBON AND SILICON IN PIG-IRON.

To the Editor of the Chemical News.

Sir,—Mr. Piesse appears to misunderstood the reason why I called the taring of a dried filter "objectionable." It was not on account of the trouble only, but chiefly because of the well-known tendency to error involved in the process, an objection which in no way applies to the dilution and filtration of potash. I work on 5 grms., and for siliceous grey irons use about an equal weight of potash. This, after dilution of the solution to about 100 c.c., filters very easily. Of course the solution is acid during the subsequent evaporation.

I cordially agree with Mr. Piesse in his admiration of Mr. Parry's process of manganese estimation. I have long been trying at something of a similar kind. Will

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* Bourne.

† "Steam-Engine and Prime Movers," p. 68.

Mr. Parry tell us why he could not succeed in using Bunsen's iodine method? It seems a great pity.

With respect to Mr. Morton's interesting paper on the condition of silicon in iron, I thought the fact of its being in true combination was not open to doubt. It is said that graphitoid silicon has been found in some specimens of foreign iron, and the discovery seems extremely probable. Is it not probable that the diminution of the amount of graphitic carbon observed by Mr. Morton when iron was heated to whiteness in hydrogen, was due to a partial combination of the carbon with iron. The latter element may be said to have been in the nascent condition as it was parting with combined silicon. An estimation of the combined carbon would at once settle the matter.—I am, &c.,

Alfred H. Allen.

Sheffield, March 9, 1874.

NOTICES OF BOOKS.

A Course of Analytical Chemistry, Qualitative and Quantitative. By W. W. Pink and G. E. Webster. London: Lockwood and Co.

If England is at present less prolific in original chemical research than are certain neighbouring countries, she is, by way of compensation, remarkably fruitful in compilations, abridgments, manuals, and elementary treatises. Upon the work before us it is not very easy to pass judgment. For its size, it contains a fair amount of information, not unmixed, we must add, with errors. It would be hard to point out any distinctive superiority which this work possesses over other works on the same subject. Such being the case, we scarcely see the reason for its publication.

The authors devote a considerable space to an exposition of "modern" chemical nomenclature and notation. They strongly advise students to obtain a complete knowledge of "constitutional" formulæ, "because the other is now not recognised by many colleges or allowed in many examinations." An important reason, certainly, in these days when, as Professor Huxley has recently reminded us, we study "not to know, but to pass," with the natural result that we "pass and do not know." But is not this exalting formulæ into an end, instead of making them a mere means to an end? Is it fair to reject a candidate well grounded in the facts of our splendid science because he is not versed in undemonstrated hypotheses and cannot express compounds in the fashionable symbols of the day? If it were desired to overtax the brain of a young man and inspire him with a loathing for chemistry, it would be difficult to devise a more effectual plan than compelling him to commit to memory a quantity of "constitutional formulæ." The old story of the doctor who thought he had explained the power of opium to produce sleep, by saying that it had a "soporific quality," repeats itself. We, too, give some new name to an old fact and dream that we have explained it.

Elements of Chemistry, Theoretical and Practical. By W. A. Miller, M.D., LL.D.; revised by Herbert McLeod, F.C.S. London: Longmans, Green, Reader, and Dyer.

Few systematic works on chemistry contain so large an amount of accurate information as the "Elements" of the late Dr. Miller. The author was remarkably successful in selecting the most valuable matter, and in presenting it to his readers in a compact and available form. Hence his book has been deservedly viewed with great favour, of which the appearance of this fifth edition is full proof.

The "revision," entrusted to the hands of Mr. McLeod, does not seem to be confined merely to the addition of facts discovered since the death of Dr. Miller. An alteration has been made in the order in which the non-metallic elements and their compounds are described. "Seven typical elements," and their respective combinations, are described before noticing those of which they are taken as representatives. Oxygen is removed from the first place to make room for hydrogen and chlorine, which latter element is, of course, separated from its analogues, bromine, iodine, and fluorine. The new arrangement is, therefore, not without drawbacks. The arrangement of the metallic elements has not been altered. "Constitutional formulæ" have been occasionally introduced, which the Editor considers consistent with the ideas developed in the earlier editions.

Exercises in Qualitative Chemical Analysis. By W. Dittmar. Manchester: Galt and Co.

These exercises are arranged in a novel manner. Instead of taking the elements or groups of elements in orthodox order, and describing their characteristic reactions in the wet way, the author commences with the reactions of such bodies as mercuric oxide, iodine, iodic acid, metallic arsenic, and arsenious acid in the dry way. From these he goes on to coloured flames, spectroscopic reactions, and the results obtained by heating metallic oxides with borax. Tests in wet way are next introduced in a similar manner, the student being gradually led from simple to more complex cases, and learning the properties of the substances examined and their characteristic reactions simultaneously with manipulative details. It seems to us that chemistry might be very successfully and thoroughly taught in this manner.

Practical Examples in Quantitative Analysis, forming a Concise Guide to the Analysis of Water, &c. By E. Francis, F.C.S. London: Lewis.

The analysis of water, though put forward in exceptional prominence in the title, is not the only topic of this work, as milk and urine are also introduced. The processes recommended are grouped respectively as gravimetric, volumetric, and colorimetric, with accompanying descriptions of the apparatus and manipulations required. As examples of the former analytical method, we have the determination of the total solids in milk and urine, the "estimation"—When will certain chemists remember that "estimation" and "determination" are in strictness two very different things?—the determination of uric acid and albumen in urine, &c. As instances of volumetry, the author gives the determination of chlorine in water, of the hardness of water, of urea in water, of sugar in urine and in milk, and of cream in milk. With the "colorimetric" section, the determination of albumenoid and ureal ammonia, which is in substance borrowed from the well-known work of Wanklyn and Chapman, our readers are doubtless well acquainted.

The following passage meets with our full approval:—"A water must not be condemned for containing nitrates, unless recent contamination is proved by an excessive yield of albumenoid and ureal ammonia." The author might have added: "A water must not be pronounced fit for human consumption on account of the *absence* of nitrates, if recent contamination is proved by a large proportion of free and albumenoid ammonia."

Price List of Chemicals. From Dr. Theodor Schuchardt's Chemical Works, Görlitz, Prussian Silesia.

A price-list of nearly 2000 chemicals, besides titrated solutions, sets of apparatus, technological collections, and minerals. A few quotations of the rarer articles may be interesting to English chemists:—Vanadic acid (pure), 4s. 6d. per grm.; bili-fuxin, bili-humin, bili-prasin, bili-rubin, and bili-verdin, 8s. 6d. per 5 centigrms.; chlorate of cæsium, 10s. 2d. per grm.; indium (metallic), 12s. per grm.; inosite, 14s. 6d. per grm.; niobium (metallic), 11s. 6d. per grm.; rubidium (metallic), 26s. per grm.; thallium (metallic), 6s. 9d. per 10 grms.; vanadium (metallic), 45s. per grm.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 19, 1874.

Theory of Shocks.—M. Resal.

Temperature observed in the Jardin des Plantes with Electric Thermometers, to 36 metres Depth, during the Meteorological Year 1873.—MM. Becquerel.—It appears that in turf-covered ground the temperature, to the extent of some decimetres under the surface, is higher at 6 a.m. than at 3 p.m. in denuded ground, and that at 3 p.m. the contrary is the case, while the average annual temperature is nearly the same in both kinds of ground. This is of some importance in vegetable physiology. For example, it is not a matter of indifference whether plants, whose roots are susceptible to frost, are put in turf-covered or bare ground.

Vibratory Movement of an Elastic Wire connected with a Tuning-Fork.—M. Gripon.—The author experimented by attaching a capillary glass tube to a tuning-fork, allowing the open end to dip in water, and noting the changes of the liquid column through vibration; or, the tube being horizontal, introducing a drop of mercury, and marking the effects of vibration.

Measurement of the Magnetic Moment of very small Magnetic Needles.—M. Bouty.—Conceive a rigid support movable about a vertical axis. Fix to this support—(1) A horizontal needle, the magnetic moment of which, M, is known; (2) a needle whose magnetic moment, x, is to be determined. The needles are placed one above the other so that their axes are at right angles, and at such a distance that their reciprocal action does not alter the distribution of magnetism in each. The system takes through terrestrial magnetism a certain position of equilibrium; the needle M making, with the plane of the magnetic meridian, an angle, a, determined by the equation—$x = M \text{ tang. } a$. The moment, x, being small enough in relation to M, the angle, a, may be ascertained by the optical method of Gauss and Weber; the image of a scale in a small mirror borne by the support is viewed with a telescope. By this method the author determined the magnetic moment of needles measuring 1 to 2 millimetres in length, and 0·2 millimetre diameter.

Thermic Formation of the Oxides of Nitrogen in the Gaseous State from their Elements.—M. Berthelot.—A lengthy paper, not adapted for abstraction.

Discovery of a Deposit of Bismuth in France.—M. Ad. Carnot.—The substance of this paper has been already given.

Methods of Producing Black Phosphorus.—M. E. Ritter.—The black state of phosphorus is traced to the presence of arsenical impurities.

Existence of Two Isomeric Modifications of Anhydrous Sulphate of Soda.—M. L. C. de Coppet.—Anhydrous sulphate of soda, obtained by drying Glauber's salt at common temperatures, is not identical with that produced by drying the same salt at temperatures above 33° C.

Solubility of Succinic Acid in Water.—M. E. Bourgoin.—This paper has been already noticed.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 6, February 5.

Sulphur in Sicily.—The amount of sulphur remaining in the Sicilian mines is estimated at 40 to 50 million tons. If the mean annual consumption should rise from 160,000 tons (the present rate) to 240,000 the supply would still suffice for two centuries.

No. 7, February 19.

This number contains no chemical matter.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19, December 22, 1873.

Continuation of Researches on Certain Oxidising and Reducing Agents.—Julius Thomsen.—A thermochemical paper.

A Third Isomer of Pyruvic Acid.—W. Markownikoff.—A preliminary notice.

On Oxypropan-Sulphonic Acid.—A hypothetical paper not adapted for abstraction.

Reply.—A. C. Oudemans.—A continuation of the controversy between the author and Landolt (Heft xvii., p. 1282).

Ultramarine Compounds.—G. Scheffer.—The author find that if the development of ultramarine is checked a yellow body is formed, which, if the process is continued, becomes red and ultimately blue. The colour passes gradually from pure yellow through orange, red, and violet, and then changes suddenly to blue, so that well-characterised blue granules may often be found in the violet. The following analyses show the composition of these successive stages:—

		I.	II.	III.	IV.
Raw.	Na_2SO_4 ..	28·83	24·50	17·95	19·32
Washed.	SiO_2 ..	49·55	46·35	49·38	50·64
	Na	8·97	9·93	11·90	12·00
	Al_2O_3 ..	22·13	23·30	20·35	20·95
	St	13·22	13·96	14·02	13·46
	$S\beta$	12·27	12·15	12·00	11·05

I. is the yellow, II. the red, III. and IV. the blue. In the above analyses the author neglected to separate the chemically combined silica from that mechanically mixed, also from the sand and the undecomposed clay. The latter substances were found in subsequent analyses to amount, on an average, to 10 per cent. St is used to signify the total quantity obtained by fusing the compound with saltpetre and hydrate of potassa. $S\beta$ denotes the amount of sulphur which remains on decomposing the substance with hydrochloric acid. Yellow and red ultramarine contain not a trace of free sulphur, which is, however, found in the blue, and can be removed by roasting or by means of bisulphide of carbon.

On Sulphoxy-Tetrachloride.—A. Michaelis and C. Mathias.—Sulphoxy-tetrachloride gradually undergoes a molecular change, and becomes a liquid of the same ultimate composition, composed of equal equivalents of thionyl-chloride and sulphuryl-chloride.

Analysis of Two Minerals from Greenland.—J. V. Janovsky (continuation).—It has been already stated that the mineral resembling zircon-syenite contains triclinar as well as monoclinar felspar. It is colourless, and is inter-penetrated here and there with green acicular crystals, which probably belong to the mineral resembling hornblende. Sulphuric and hydrochloric acids do dot readily attack the pulverised mineral. Before the blowpipe it fuses only at the angles. The specific gravity is 2·638; it contains—

Silicic acid	57·63
Alumina	24·32
Ferric oxide	3·92
Lime	7·65
Magnesia	0·68
Potassa	4·03
Soda	2·41
Loss on ignition	0·12
	100·76

From the ratio of the oxygen, 7 : 3 : 1, it corresponds with labradorite rather than with oligoklas.

Analysis of a Mineral from Orawioza.—J. V. Janovsky.—The mineral in question, which has been considered as Gehlenit, is green and granular. Closer examination showed that these green granules contained Vesuvian. The Gehlenit is superficially covered with a reddish-brown crust, which is soft and easily separated from the rest of the mineral. The green olivin-like granules are hard, with white streak; the finely ground substance is easily decomposed by hydrochloric acid and gelatinises. Before the blowpipe it does not even fuse superficially. The specific gravity is 2·997; it contains—

Silica	32·39
Alumina	18·53
Ferric oxide	1·25
Ferrous oxide	3·61
Lime	37·65
Magnesia	6·69
Loss in igniting	0·51
	100·63

The imbedded grains of Vesuvian are grey, streak reddish. They lose on ignition 2·12 to 2·34. They contain—

Silica	36·31
Alumina	23·36
Ferric oxide	2·99
Ferrous oxide	0·51
Lime	25·32
Magnesia	5·19
Potash	3·35
Water	2·12
	99·15

The superficial crust above-mentioned is soft, amorphous, garnet-coloured; before the blowpipe it gives the reactions of silica and iron, and gives off much water if heated in a flask; it contains—

Silica	27·98
Alumina	30·23
Ferric oxide	8·51
Water	29·36
Carbonate of Lime ..	3·76
Carbonate of magnesia	0·55

Chemical Intelligence from St. Petersburg.—A. Kuhlberg.—A. Tawildarow is still engaged with an examination of the bromine substitution products of ethan. A. Scherbatshew has investigated the relation between the solubility of salts and their crystalline water. N. Ljubavin has continued his researches on the action of ammonia upon valeraldehyd. Setschenow has examined the absorption of carbonic acid by saline solutions. Louginin has made a communication on the amount of heat liberated when the anhydrous chlorides of certain fatty acids are decomposed by water and solution of potassa.

Intelligence from Lund.—W. Blomstrand.—Mauckhoff gives a description of the masses of native iron found in the basalt of Ovifak, in Greenland, with analyses of the accompanying minerals. Oeberg has examined the eukrit of Radmon Island, in Upland. C. M. Feilitzen has analysed Swedish dolomites and magnesiferous limestones from various localities. De Laval's investigations on the chlorides of tungsten confirm the results previously obtained by Lund. Atterberg has examined the bromine compounds of molybdenum. Pahl's dissertation on the pyrophosphates is an important contribution to our accurate knowledge of that class of salts. Cronander has experimented on the compounds of perchloride of phosphorus with the chlorides of arsenic, tungsten, molybdenum, uranium, chrome, and iron. Petersson has investigated the selenic alums, and the quantitative determination of selenic acid. He prefers Bunsen's method as directed for chromic acid. The substance is boiled with concentrated hydrochloric acid, and the liberated chlorine determined by means of iodine and hyposulphite of soda. P. Hakonsson has examined toluol-disulphuric acid. Paykull has experimented on the compounds of zirconium. Cleve and Hoglund have studied the yttrium and erbium compounds. They confirm the results of Berlise, Bahr, and Bunsen, and show that Mosander's terbia is a mere mixture of didymia, yttria, and erbia. They determine the equivalent of yttrium as 59·70, and that of erbium 113·7. Quantitative methods of separating the two earths are still wanting. Cleve's dissertation on the platinum bases, drawn up in the English language, appears in the *Svenska Vetenskaps Aks. Handlinger*, 1872, vol x., No. 9. Topsoe and Christiansen have published in the *Danske Vidensk. Selsk. Skr.*, 5 r., band ix., 1873, their important crystallographic optical researches. H. Hvoslef obtained santonic acid in 1863 by the method adopted subsequently by Cannizzaro and Sestini.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 1, January, 1874.

Report Presented by M. Cloëz, on behalf of the Joint Committees of Chemical Arts and of Agriculture, on a Remonstrance of the Paper Manufacturers against the Proposed Duty on Salt Employed in Chemical Works.—The report shows the serious injury which the paper trade must suffer from an increase in the price of chloride of lime and of soda.

Apparatus for Decanting and Treating Ammoniacal Liquor Employed at the Vaugirard Works of the Paris Gas Company.—The ammoniacal liquor is pumped into the first of four large tanks, and after being allowed to settle, passes successively over very shallow outlets into the three others, and is thus freed from tarry matters.

Colouration of Glass with Gold.—M. Payard, chemist to the Baccarat Glass Works.—Gold serves in the glass manufacture to produce rose and red shades. A certain quantity of auriferous glass is prepared beforehand, and run in thin plates. Fragments of these plates are used by the glass-blower to fuse upon his work, and thus give a superficial colouration. It often happens that one and the same composition of auriferous crystal gives plates of very different shades, some colourless, others tinged more or less deeply with rose or red, and some almost black. These differences are due to two physical causes—the temperature of the furnace in which the fusion has been effected, and the temperature of the mould into which the melted material is run. For light coloured plates the temperature of the furnace must be low, and the mould very cold. Blue plates are sometimes produced under the same circumstances, which, if re-heated, take the normal colour, as do also the colourless and very pale rose glasses. These curious facts render it probable that the colouring matter is neither a salt nor an oxide, but a simple body. Crystal coloured with gold is therefore merely a vitreous matter holding in suspension metallic gold in a state of very fine subdivision. On attentively examining the red plates it is easy to recognise in the mass a multitude of brilliant specks of metallic gold forming a sort of aventurine.

MISCELLANEOUS.

Andersonian University.—The Trustees of the "Young" Chair of Technical Chemistry met with the Bursars studying for the last two years under that Chair in the University on January 28. Mr. James Napier, F.C.S., one of the Trustees, intimated the results of the competitive examination which had taken place on December 23. Mr. Napier said the Trustees felt it due to the donors of the bursaries to be able to show what progress was being made by the students, and for this purpose a series of questions upon the branches of chemistry which had formed the course of study for the two years had been prepared by Dr. Robert Angus Smith, F.R.S., Manchester, and placed before the students for written answers, on the occasion referred to. The papers containing the answers had been immediately transmitted to

Dr. Smith, and the result was now communicated to the students—prizes, the gift of the Professor, being awarded to the two whose names stood highest on the list. Dr. Smith stated in his report that "the students appear to me to have attained a great amount of accurate knowledge of a very practical kind, and if the institution sends out men with such information, and so capable of expressing it, the duty laid upon it is most effectively performed." Mr. Napier then urged on the students close attention to their studies, and asked them not to forget that technical chemistry was greatly promoted by a knowledge of natural philosophy, and that proficiency in science can only be attained by hard labour. Professor Bischof expressed the hope that ere long the fact of young men having passed through a course of technical science in the Andersonian University would be regarded as a recommendation by manufacturers, and concluded by proposing a vote of thanks to Mr. James Young for his liberality in establishing the Chair, and to the donors of the bursaries for their kindness in enabling the students present to obtain the knowledge which they had exhibited.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved sheep dip, which is also applicable to animals other than sheep. Michael Wheelwright Ivison, civil engineer, Glasgow, Lanark, North Britain. April 17, 1873.—No. 1385. The feature of novelty which constitutes this invention consists in compounding or mixing together green gas oil, palm oil, or other grease or fat, caustic soda, caustic potash, water, and glue, so as to form a dip for sheep and other animals.

Improvements in the treatment of night-soil and sewage matters, and in the manufacture of manures therefrom. Henry Young Darracott Scott, Major-General, C.B., Ealing, Middlesex. April 21, 1873.—No. 1445. The object of this invention is the economical and inoffensive treatment of sewage and night-soil. The process essentially consists in the utilisation of the deposit obtained from liquid sewage by the lime method of precipitation, for the deodorisation of the night-soil of towns, and the retention of the fertilising elements of such excrementitious matters.

An improved compound to be used as a vehicle for paints used in house, ship, and general work. Joseph Edmond Tavenet, Paris, France. April 21, 1873.—No. 1446. This improved vehicle, to be used as a substitute for linseed or other siccative oil or liquid, is composed of—100 parts, by weight, of hot water; 4 parts of potash; and 6 parts of carbonate of soda. This mixture, when dissolved, is boiled, and 2 parts of colophony and 10 parts of oleic acid then added separately; after which the whole is boiled until completely dissolved. The proportions specified may be varied.

Improved combinations of ingredients for cleansing and bleaching wools and other suitable fibres and fabrics. James Bateson Rickards, "The Green," Kilburn, Middlesex. April 22, 1873.—No. 1460. Combination No. 1 consists of—Silica, soda, charcoal, sand, dissolved in water. Combination No. 2 consists of—Silica, potash, charcoal, sand, and water as before.

Improvements in the manufacture of gas for illuminating and other purposes, and in apparatus connected therewith. Isham Baggs, practical chemist, High Holborn, Middlesex. April 23, 1873.—No. 1471. This invention consists in certain improved methods of obtaining, treating, separating, and purifying gas for illuminating and other purposes, obtained by the decomposition of water in connection with incandescent carbonaceous materials, and which methods are partly improvements upon an invention for "Improvements in the manufacture of inflammable gases and in their application to useful purposes," for which Letters Patent were granted to the applicant, bearing date the 23rd day of October, 1865, No. 2719.

Improvements in the production and treatment of colouring matters. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Edward Croissant and Louis Marie François Bretonnière, both of Paris). April 24, 1873.—No. 1489. This invention relates to a mode of obtaining colouring matters soluble in water, suitable for dyeing textile fibrous substances of all kinds, from organic substances not hitherto employed for that purpose, by a simple and economical process, which process is also applicable to the treatment of known colouring matters, with a view to improving the quality of the colouring matter so treated. The improved process consists in the direct treatment of the organic or other body to be operated upon with alkaline sulphides or polysulphides at a more or less elevated temperature, which may range from 100° Centigrade to, say, 350°, according to the nature of the substance under treatment and the tint required—he more elevated the temperature, the darker being the tint obtained.

Improvements in recovering iodine from phosphates of lime during the manufacture of superphosphate of lime, and in apparatus therefor. Dr. Louis Thiercelin, Paris. April 25, 1873.—No. 1500. The object of the invention consists in recovering the iodine from phosphates of lime during the manufacture of superphosphate of lime, which I obtain by causing the sulphuric acid to act on the phosphate in a closed vessel instead of an open vessel as was hitherto done, which vessel communicates with an air-pump or other exhausting apparatus for carrying the evolved vapours and iodine into a condensing chamber and in suitable alkaline solutions.

Improvements in the treatment of sewage matters and the deodorisation of night-soil. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. April 25, 1873.—No. 1509. Instead of converting into charcoal as heretofore the solid matters deposited from sewage by precipitation with lime or lime and clay, I subject them to a temperature only sufficiently high to decompose their organic matters, and so far scorch or only partially char them, so as to develop in them compounds of a tarry nature, but not completely to expel such compounds as is done in the preparation of charcoal. Sewage deposits thus treated exercise a remarkable effect in destroying the noxious smell of putrescent compounds, and they may be used with great advantage in deodorising night-soil and rendering it innocuous.

NOTES AND QUERIES.

Separation of Magnesium and Calcium.—Will any of your numerous readers kindly inform me as to the best method of separating manganese and calcium, when the latter is in large excess.—Owen Morgan.

Maize Flour.—Can any of your readers inform me if maize flour of fine quality will make good dessert biscuits, and whether, commercially speaking, it would pay to use such maize flour for said purpose, provided it could be prepared at a cost below that of wheaten flour.—A. K.

Manufacture of Soda Crystals.—Permettez moi d'avoir recours à votre obligeance habituelle pour me renseigner si possible sur le sujet suivant. Les usines de cristaux de soude Anglaises peuvent-elles fabriquer en été, et dans ce cas vouloir bien in indiquer quel est le procédé employée pour obtenir une température assez basse, afin que la cristallisation puisse opérer.—P. G. Clavel.

Notes on the Utilisation of Sewage.—(From the "Report o the Main Drainage Committee for 1864," vol. 487).

4063. (To Mr. Rawlinson.) The river Aire, which passes through Leeds and Bradford, is stated to be as bad as the Medlock; is that the case?—It is very foul.

4064. I believe the mud which is deposited in that stream is raised up by the floods, when they come down, and stinks and putrefies for a long way down the river?—It is so. The facts appear to be these, that in those rivers in Manchester, the sewage matter combines in some way with the subsoil; and fermentation takes place; you see the gas rise up in a bubble, and a mass of scum with it which cakes on the surface. You might skim the Bridgewater Canal at Manchester, and cleanse it completely every four and twenty hours; and this process of putrefaction with the subsoil takes place, and raises this scum, and again cakes and covers the surface.

4074. (To Mr. Rawlinson.) Then if it were remunerative to remove the matters of the cesspools to the land in former days by means of carts, will it not be still more remunerative in these days to remove it by means of suspension in water through mains, and with pumping engines?—There is no doubt about it; you can pump by those engines in the Lambeth works, which stand almost opposite this house, I believe, above 80,000 gallons 100 feet high, at a working cost (including coals, tallow, and wages) of 1s., and you would lift sewage on a large scale for the same money.

4104. (To Mr. Rawlinson.) In the case of Edinburgh, is not that a mode of application that will not be adopted at present by any town that commenced works afresh?—In Edinburgh they have the sewage for nothing; they have it entirely their own way: it has been applied to some of those meadows above 200 years, and this fact has been very useful as showing that land will continue to utilise it for a great length of time. Putrid town sewage has been applied at Edinburgh for above 200 years to the same portion of land, and from that down to the present time, the same land has given off a beneficial crop, and it is not proved to have been prejudicial to the health of the district. But it is applied rudely in large open carriers in which the sewage is floated along, and it is in those open carriers, where putridity continues from the scum and sediment on them, that you have the nuisance and the stench which has been referred to, and not from the irrigated area where the growing plants exist.

4209. (To Mr. Rawlinson.) Would your experience lead you to say that no such nuisance need really be occasioned?—I am satisfied that if this room were a grass-plot, you might irrigate it every morning and not have any perceptible smell from it within half an hour after irrigation.

4210. But if there were a perceptible smell for half an hour after, would not that be a nuisance that would justly be complained of?—It might be, but even that evanescent smell might be very cheaply got rid of by using a disinfectant.

4211. At what point in the system could you use a disinfectant?—Immediately before pumping. The sewage of Carlisle has been for four or five years used upon the meadows which are bounded by the river Eden, and Mr. McDougall, who is the patentee of a disinfecting fluid, does use it before the sewage water goes on to the land, and I understand that there is no perceptible smell at all from it.

4212. Do you know whether there is much expense attending the use of that disinfecting fluid?—Not very much.

4213. (To Mr. Rawlinson.) Could the use of such a fluid be very easily and practically applied to the whole of the sewage of London?—I believe that he applied his disinfectant during that very hot summer in 1859 to a portion of the district of London, and I think that the calculations as to the expense have shown us that you may use a disinfectant of that kind, varying from lime at £1 per 1,000,000 gallons up to perchloride of iron at £3 per 1,000,000 gallons, and the effect would be completely to destroy the smell for a time, and if you applied the sewage to land at once, the effect would be effectually to destroy all smell.

THE CHEMICAL NEWS.

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ON THE
AMOUNT OF EXHAUSTION OBTAINABLE BY SPRENGEL'S MERCURIAL AIR-PUMP.

By W. F. DONKIN, M.A.

In the early part of the year 1870 I made a series of experiments with the object of ascertaining the limit of the exhaustion attainable by means of the Sprengel pump. The pump used was similar in construction to that described by Mr. McLeod in a paper on the determination of the gases in water (*Journ. Chem. Soc.*, N.S., vol. vii., p. 311), including the syphon-tube, or "air-trap," interposed between the funnel and the fall-tube.

The method used consisted in—(1) exhausting a glass vessel, to which was attached a capillary tube sealed at the end; (2) letting mercury run into the vessel, so as to enclose all the residual air in the end of the capillary tube; (3) measuring the volume of this residual air, and comparing it with that of the vessel exhausted. The vessel used was a pipette of 50 c.c. capacity, one end of which was drawn out to a fine capillary tube and sealed, and the other end adapted to the pump. In the earlier experiments the vessel used was a bulb, which was sealed off after the exhaustion, and the end broken off under the surface of mercury. There was reason, however, to believe that air was carried in by the violent rush of the mercury, particularly if the end of the glass tube was broken against the bottom of the vessel containing the mercury; at any rate there was no proof that this was not the case; and therefore in all the subsequent experiments a neat device was made use of for introducing the mercury which was suggested to me by Mr. McLeod, and which consisted in closing the bottom of the fall-tube of the pump after the exhaustion, while the pipette was still attached to its upper end, so that the mercury was driven up into the pipette without any chance of carrying in air along with it. The end of the capillary tube was then broken off so as to enclose the residual air by a short column of mercury. Care was taken that the closed end of the capillary tube should be above the level of the mercury in the funnel of the pump, so that on breaking it off the column of mercury was driven a little further into the capillary tube. The two ends of the column being thus in the same condition as regards capillarity, no error through alteration of volume of the enclosed air from this cause could occur.

The next operation was to measure the volume of the enclosed air; and, since in the more complete exhaustions it was barely visible to the naked eye, the only chance of doing this with any approach to accuracy was to measure it under a microscope with a micrometer. For this purpose the little piece of tube was mounted on a slide in Canada balsam, the open end being left exposed to the air, and the length and diameter of the part of the tube enclosing the air was carefully measured. The micrometer used reads to 1-20,000th of an inch, and thus gave the results in cubic inches. These were converted into cubic centimetres by multiplying by the constant 16·386; so that if l and r are the length and radius of the part of the tube enclosing the air, its volume in cubic centimetres is $16{\cdot}386 \times l\pi r^2$, and the fraction representing the exhaustion attained (the capacity of the pipette being 50 c.c.) is—

$$\frac{16{\cdot}386 \times l\pi r^2}{50}.$$

The pipette was attached to the pump by means of a short and rather thick piece of black india-rubber tubing, and the joint was surrounded by glycerin.

The experiments were made with the apparatus arranged in four different ways, with the object of ascertaining—(1) whether the above joint is a satisfactory one, and (2) whether the air-trap has any effect in increasing the amount of exhaustion.

In order to decide the first point, several experiments were made after removing the air-trap altogether, (*a*) with the india-rubber joint, (*b*) with the pipette sealed hermetically on to the top of the fall-tube.

In the first series (*a*), consisting of five experiments, the exhaustion attained appeared to improve successively, although the time occupied and the quantity of mercury used was approximately the same in each case, the fractions obtained varying from 1-229,300th to 1-10,770,000th. The reason of this probably lies in the fact that the same piece of india-rubber was used as a connector in all the experiments, and that the gases originally occluded in it got gradually pumped out.

A few exhaustions were now made (series *b*) after removing the india-rubber, and sealing the pipette on to the pump. The lowest fraction obtained was 1-15,330,000th, which is rather lower than the best of those in series *a*. It appears then that, if the air-trap is notinterposed, a well-used india-rubber joint immersed in glycerin is as good a means as any for connecting vessels to be exhausted with the pump.

In order to decide the second point, viz., the value of the air-trap, two more series of experiments were made after replacing the air-trap—(*c*) with the same india-rubber joint as before; (*d*) after sealing the pipette again on to the pump. The best exhaustion obtained in series (*c*) was represented by 1-21,428,000th, and those in series (*d*) by the fractions 1-211,866,000th, 1-308,260,000th, and 1-937,920,000th.

From this it is evident that, so long as an india-rubber joint is used, the air-trap has but little effect in increasing the amount of exhaustion obtained; but that, when the pipette is sealed on to the pump, it is the air-trap which makes all the difference, the exhaustions becoming much more perfect. The air-trap is, in fact, an arrangement by which the mercury is made to pass through a vacuous space before reaching the pump. The mercury which has been in contact with the air appears to carry with it, possibly in solution, a small quantity of air which it will give up into an empty space, and if this space is the vessel to be exhausted, it is plain that the exhaustion cannot be carried beyond a certain limit; whereas, when the mercury has passed through a preliminary vacuum, where it can leave its dissolved or adherent air, there appears to be no definite limit to the exhaustion attainable, the difference in the three experiments (series *d*) depending on the length of time during which the pump was in action. In the last of them, for example, the mercury was allowed to run for at least an hour at the rate of about two drops per second, after the exhaustion was apparently complete.

In the case of the small volumes represented by the three last fractions, the probable errors of measurement become relatively large, and they are further increased by the fact that the volumes are not cylindrical. When a very fine capillary glass tube is sealed by momentary exposure to the edge of a flame, as was the case in all the above experiments, the interior form of the sealed end is nearly that of a pin's point, or (in section) the bows of a ship with very fine lines. In the three last experiments the mercury was driven quite into the pointed part of the tube, and in the last was more than half way up it. Now, assuming the longitudinal curvature of the sides to be circular, the volume of such a solid, from the apex to the base of the conical part, is about 0·42 of its circumscribing cylinder. This correction was applied in each case except the last, where the volume was taken as that of a cone, from which it did not appreciably differ, and was therefore one-third of the circumscribed cylinder.

As an example of the mode of calculation, the numbers obtained in the experiment from series *c* may be given:—

Length of bubble = 0·0705 inch.
Radius of tube = 0·0008 „

$$\therefore r^2 = 0\cdot00000064.$$

$$\frac{l\pi r^2 \times 16\cdot386}{50}.$$

$$\begin{aligned}
\log.\ 0\cdot0705 &= \bar{2}\cdot8481891\\
+\log.\ r^2 &= \bar{7}\cdot8061800\\
+\log.\ \pi &= 0\cdot4971500\\
+\log.\ 16\cdot386 &= 1\cdot2144730\\
\hline
&\quad \bar{6}\cdot3679921\\
\log.\ 50 &= 1\cdot6989700\\
-\log.\ \text{numerator} &= \bar{6}\cdot3679921\\
\hline
&\quad 7\cdot3309779
\end{aligned}$$

$$n = 21{,}428{,}000.$$

and the fraction is—

$$\frac{1}{21{,}428{,}000}.$$

In this experiment, the diameter of the tube was taken as 0·0016 inch. Now, if the reading had been taken as 0·00165 inch, the radius would have been 0·000825 inch, and the fraction expressing the exhaustion 1-20,150,000th. The difference, however, between the above readings was clearly perceptible, and there was no doubt that the smaller one was the most accurate.

A similar alteration in the readings obtained in the last experiment of series (*d*) causes relatively a much larger alteration in the final result, the fraction in this case becoming 1-836,610,000.

It appears, then, from these experiments that the Sprengel pump may be made to give an exhaustion down to 1-10,000,000th in its simplest and most convenient form, viz., without an air-trap, and with an india-rubber joint immersed in glycerin; but that, if a very complete exhaustion is required, the air-trap must be used, and the vessel to be exhausted must be sealed hermetically on to the pump.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 116).

Section V.—Calculation of the Results.

The succeeding results must not be regarded as embodying all the attempts to determine the atomic weight; for, as stated in the preceding section, many of the apparatus were broken at various stages of the operation. The calculations, however, serve to illustrate the weighings which came to a successful issue.

For the accurate determination of the weighings, it will be seen that it is necessary to ascertain the density of the ordinary atmosphere at the place where the weighings are made. Ritter has deduced from Regnault's observations that in Paris, lat. 48° 50′ 14″, at 60 metres above the level of the sea, a litre of dry atmospheric air at 0° C. and 760 millims. pressure weighs 1·2932227 grms. It is well established that, if G represents the force of gravity at the mean level of the sea in lat. 45°, the force of gravity in lat. λ at the mean level of the sea $= G(1 - 0\cdot0025659 \cos 2\lambda)$.

The force of gravity in a given latitude at a place on the surface of the earth at a height, z, above the mean level of the sea—

$$= \left\{1 - \left(2 - \frac{3\rho'}{2\rho}\right)\frac{z}{r}\right\}$$

multiplied by the force of gravity at the level of the sea in the same latitude, r being the radius of the earth = 63966198 metres, ρ its mean density, and ρ' the density of that part of the earth which is above the mean level of the sea; and, if the ratio $\rho' : \rho$ be taken as 5 : 11, then—

$$2 - \frac{3\rho'}{2\rho} = 1\cdot32 \text{ nearly.}$$

Continuing the reasoning, Professor Miller has shown that a litre of dry atmospheric air, containing the average amount of carbonic acid, at 0° and 760 millims. pressure, at the height z above the mean level of the sea in lat. λ, weighs in grammes—

$$1\cdot2930693\left(1 - 1\cdot32\frac{z}{r}\right)(1 - 0\cdot0025659 \cos 2\lambda).$$

It has been shown by Regnault and others that, between 0° and 50°, the ratio of the density of air at 0° to its density at $t°$ is $1 + 0\cdot003656t$, and that the density of the vapour of water is 0·622 of that of air. Therefore the weight in grammes of a litre of air will be—

$$\frac{1\cdot2930693}{1 + 0\cdot003656t} \cdot \frac{b - 0\cdot378v}{760}\left(1 - 1\cdot32\frac{z}{r}\right)(1 - 0\cdot0025659 \cos 2\lambda),$$

where t is the temperature of the air, b the barometric pressure, v the pressure of the vapour (of water) present in the air, both expressed in millimetres of mercury at 0°, z the height above the mean level of the sea, λ the latitude. My laboratory at Mornington Road, Regent's Park, where the atomic weight of thallium was determined, is in lat. 51° 32′ 6″, at a height of 35·05 metres above the mean level of the sea. The expression consequently becomes—

$$\frac{1\cdot2930693}{1 + 0\cdot003656t} \cdot \frac{b - 0\cdot378v}{760}(\cdot9999289815)\,(1\cdot0005802549).$$

As a litre is the volume of 1000 grms. of water at its maximum density, the division of this expression by 1000 gives the ratio of the density of air to the maximum density of water. By the addition of the logarithm of $b - 0\cdot378v$ in millimetres to log. A_t we obtain the logarithm of the ratio of the density of air at $t°$ to the maximum density of water.

Table A.—Calculated for Mornington Road, Regent's Park.

t.	10 + log. A_t.	Diff.
0	4·231055	
		1585
1	4·229470	
		1579
2	4·227890	
		1574
3	4·226317	
		1567
4	4·224750	
		1563
5	4·223187	
		1556
6	4·221631	
		1551
7	4·220980	
		1545
8	4·218535	
		1540
9	4·216995	
		1535
10	4·215460	
		1529
11	4·213931	
		1524
12	4·212407	
		1518
13	4·210889	
		1513
14	4·209376	
		1508
15	4·207868	
		1502
16	4·206366	
		1498
17	4·204868	
		1492
18	4·203376	
		1487
19	4·201889	
		1483
20	4·200406	
		1477
21	4·198925	
		1471
22	4·197458	
		1468
23	4·195990	
		1462
24	4·194528	
		1457
25	4·193071	
		1452
26	4·191618	
		1447
27	4·190171	
		1443
28	4·188728	
		1438
29	4·187290	
		1433
30	4·185857	

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* A Paper read before the Royal Society June 20, 1872.

Table B.—Values of $0·378 \times ⅔ v_t$, where v_t is the maximum pressure of vapour at the temperature t, in millims. of mercury at 0°, according to Regnault's observations.*

t.	0.	1.	2.	3.	4.	5.	6.	7.	8.	9
0	1·16	1·17	1·18	1·18	1·19	1·20	1·21	1·22	1·23	1 24
1	1·25	1·25	1·26	1·27	1·28	1·29	1·30	1·31	1·32	1·33
2	1·34	1·35	1·36	1·37	1·37	1·38	1·39	1·40	1·41	1·42
3	1·43	1·44	1·45	1·46	1·47	1·48	1·49	1·50	1·51	1·53
4	1·54	1·55	1·56	1·57	1·58	1·59	1·60	1·61	1·63	1 64
5	1·65	1·66	1·67	1·68	1·69	1·70	1·72	1·73	1·74	1·75
6	1·76	1·78	1·79	1·80	1·81	1·82	1·84	1·85	1·86	1·87
7	1·89	1·90	1·91	1·93	1·94	1·95	1·96	1·98	1·99	2·01
8	2·02	2·03	2·05	2·06	2·08	2·09	2·10	2·12	2·13	2·15
9	2·16	2·17	2·19	2·21	2·22	2·24	2·25	2·27	2·28	2·29
10	2·31	2·32	2·34	2·35	2·37	2·39	2·40	2·42	2·44	2·45
11	2·47	2·48	2·50	2·52	2·53	2·55	2·57	2·58	2·60	2·62
12	2·64	2·65	2·67	2·69	2·71	2·72	2·74	2·76	2·78	2·80
13	2·81	2·83	2·85	2·87	2·89	2·91	2·93	2·94	2·96	2·98
14	3·00	3·02	3·04	3·06	3·08	3·10	3·12	3·14	3·16	3·18
15	3·20	3·22	3·24	3·26	3·28	3·31	3·33	3·35	3·37	3·39
16	3·41	3·43	3·46	3·48	3·50	3·52	3·54	3·57	3·59	3·61
17	3·63	3·66	3·68	3·71	3·73	3·75	3·78	3·80	3·82	3·85
18	3·87	3·90	3·92	3·95	3·97	4·00	4·02	4·04	4·07	4·09
19	4·12	4·15	4·17	4·20	4·22	4·25	4·28	4·30	4·33	4·36
20	4·38	4·41	4·44	4·47	4·49	4·52	4·55	4·58	4·61	4·63
21	4·66	4·69	4·72	4·75	4·78	4·81	4·84	4·87	4·90	4·92
22	4·95	4·99	5·02	5·05	5·08	5·11	5·14	5·17	5·20	5·23
23	5·26	5·30	5·33	5·36	5·39	5·43	5·46	5·49	5·52	5·56
24	5·59	5·62	5·66	5·69	5·73	5·76	5·80	5·83	5·87	5·90
25	5·93	5·97	6·01	6·04	6·08	6·12	6·15	6·19	6·22	6·26
26	6·30	6·34	6·37	6·41	6·45	6·49	6·53	6·56	6·60	6·64
27	6·68	6·72	6·75	6·79	6·83	6·87	6·91	6·95	6·99	7·03
28	7·08	7·12	9·17	7·21	7·25	7·29	7 34	7·38	7·42	7·46
29	7·51	7·55	7·59	7·64	7·68	7·73	7·77	7·82	7·86	7·91
30	7·95	8·00	8·04	8·09	8·14	8·18	8 23	8·28	8·23	8·37

* *Annales de Chimie*, 1845, 3me serie, tome xv., p. 138.

These logarithms, when increased by 0·000030, agree with those employed by Professor Miller in his determination of the value of the new standard pound (see *Phil. Trans.* for 1856) when working in the cellar under the Mineralogical Museum at Cambridge, in lat. 52° 12′ 18″, about 8 metres above the mean level of the sea; increased by 0·000002 they can be used in reducing weighings in Somerset House, lat. 51° 30′ 40″, 29·56 metres above sea-level; or diminished by 0·000102 for weighings made in Paris.

We have next to consider the influence exerted by the hygrometric state of the atmosphere, or, in other words, the influence of the vapour of water suspended in the atmosphere. It is clear that the moist air is nothing more than a mixture of v cubic inches of dry air at $t°$ under a pressure *minus* that of the vapour, and of v cubic inches of vapour at $t°$ and the pressure resulting from the hygrometric condition. Biot, Regnault, and Bianchi have ascertained that the pressure of vapour in an ordinary dry room is two-thirds of the maximum pressure due to the temperature.

(To be continued.)

NOTE ON A

NEW METHOD OF TAKING SPECIFIC GRAVITIES, ADAPTED FOR SPECIAL CASES.

By E. SONSTADT.

The method to be described I devised some years ago for the purpose of quickly and accurately comparing together the specific gravities of different specimens of certain alkali salts, and especially chloride and sulphate of potassium. I have found the method very convenient, not only in these cases, but also whenever wanting to know the sp. gr. of any mineral not so heavy as to sink in such a liquid as could be conveniently made and used.

For taking the sp. gr. of specimens of chloride of potassium and of potassium alum I used iodide of ethyl, which, having been prepared from commercial "methylated spirits," contained a few per cents of iodide of methyl, and had a sp. gr. of about 2°. This was diluted by bisulphide of carbon* until, at the temperature of the experiment, a standard specimen of the chloride of alum, prepared with great care and of proved purity, neither rose nor sank when immersed in the liquid. The crystal could then be made to swim or sink by a very slight alteration in the temperature of the liquid, such as might be produced by holding the bottle a moment in the hand, or by placing it in a cooler part of the room. When the liquid is standardised, say, to pure chloride of potassium, any specimen of that salt may at once be examined by dropping it into the liquid still containing the standard crystal. If the specimen contain even only a trace of sodium, rubidium, or cæsium, it will be known by its greater specific gravity, and consequent tendency to sink in the liquid that supports the pure specimen. The difference may be only just perceptible, or it may be considerable. Slight differences may be quantitatively determined by observing through how many degrees of temperature the liquid must be cooled to bring the heavier specimen into equilibrium. Larger differences require for their determination a series of bottles containing liquids so adjusted that the intervals between may be filled up by moderate changes of temperature. If the crystal examined is heavier at one end or side than at the other, this difference will be shown by the heavier end always being below after coming to rest, however often it may be shaken up. This is remarkably the case with crystals of chloride of potassium prolonged in one direction. The end last formed I have found to be specifically the heaviest. When an alum is examined, it will be found that the presence of any trace of ammonia lowers the sp. gr., while the presence of sodium, rubidium, or cæsium increases it. Sodium appears to be always present in potassium alum crystallised out of a liquid containing much of any salt of sodium; nor can the sodium be completely separated by one re-crystallisation. When potassium alum is perfectly pure, I did not find the sp. gr. of the crystals vary in the least under different conditions of formation. In one instance seven re-crystallisations gave crops from which specimens were selected, and proved to be of perfectly equal sp. gr. Yet, if a trace of rubidium is contained in an otherwise pure potassium alum, so minute that the spectroscope fails to detect it in the ordinary gas flame, and only shows the principal rubidium lines in the flame of hydrogen burning in air, that specimen of alum will be distinguishable from the pure salt when crystals of the two are placed together in a well-adjusted liquid. This fact illustrates the extreme delicacy of this method of comparing specific gravities.

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* Chloroform may be used as a diluent instead of bisulphide o carbon, but less advantageously. In either case, the liquid gains in sp. gr. by exposure to the air, owing to the greater volatility of the diluent; but the change is much more rapid when chloroform is used than when, as recommended in the text, bisulphide of carbon is used. The liquid soon becomes coloured by separation of iodine, but this may be prevented by keeping in it magnesium or copper wire, or filings.

In testing the sp. gr. of sulphate of potassium and of many minerals, I have used a solution in water of pure iodide of potassium and pure mercuric iodide. To form this solution, a saturated solution is taken at common temperature of iodide of potassium, and as much mercuric iodide is stirred up in it as it will dissolve. It will then dissolve more iodide of potassium, then more mercuric iodide, and so forth. The iodides dissolve very slowly at the last, and as it is best not to accelerate the solution by the application of heat, considerable time must be allowed when a liquid of maximum strength is required. The solution, after filtering, is fit for use, and may be obtained, without danger of its crystallising above zero, of sp. gr. 3·085 at 12° C. This liquid is transparent, very mobile, filters easily, is of an amber colour, gives no precipitate on addition of water, and does not readily lose or gain water on long exposure to the atmosphere. When diluted to the sp. gr. of sulphate of potassium, it has scarcely any solvent action on that salt, which, however, if kept in it for a month or more, becomes roughened. Practically, over any moderate time, it has no action. The solution undergoes no perceptible chemical change by free exposure to the air over many months. It may be diluted to any extent, and then concentrated by heat, without injury.

When this liquid is diluted so that quartz will just float on it, any mineral heavier than quartz will of course sink. As many minerals closely resemble quartz in external characters, and can be distinguished more readily by their sp. gr. than in any other way, this method of testing the sp. gr. furnishes a very quick and certain means of discrimination. A small bottle of the liquid, containing, say, half an ounce, and carried in the waistcoat pocket, would enable the mineralogist to make a great many examinations on his walks, as to whether the specimens he examined were above or below a certain sp. gr. The smallest distinctly visible particle of a mineral is enough for a determination. After the bottle became clogged with specimens, the liquid might be poured out for further use, and if the washings were added, and the whole concentrated, there need be no sensible waste.

I have thought that perhaps this liquid might be found serviceable for separating diamond-dust, or small diamonds and other gems, from quartz-sand.

New Hydrocarbon of the Stilben Series.—G. Goldschmiedt and E. Hepp.—Dimethyl-stilben was obtained both by the reduction of ditolyl-trichlor-ethan with zinc-powder, and by distilling ditolyl-monochlor-ethan. It forms iridescent leaflets which melt and sublime at 176° to 177°. It boils above 300°, and has the composition $C_{16}H_{16}$. It is remarkably analogous to stilben. It is readily soluble in sulphide of carbon, ether, and boiling alcohol, but less easily than stilben.—*Ber. d. Deuts. Chem. Ges. zu Berlin.*

ON THE METHODS OF ANALYSING WATER.*

By FERD. TIEMANN.

The author treats of the determination of nitric acid, for which we have—

I. *Methods Founded on the Conversion of the Nitric Acid in an Alkaline Solution into Ammonia.*

Schulze was the first to establish a process upon this principle, followed by Wolf, Harcourt, and Siewert. The method and apparatus have been modified by Bunsen, Chapman, and others. Schulze reduces with platinised zinc; Wolf, Harcourt, and Siewert with zinc and iron-filings; Bunsen with a spiral of zinc and iron; and Chapman with aluminium-foil. Wolf points out the necessity of conducting the reduction in a cold solution. Frühling maintains that the methods founded on this principle are inaccurate in presence of organic matter. Finkener infers from his experiments that all the nitric acid is decomposed. The author passes an unfavourable judgment upon all these methods.

II. *Determination of Nitric Acid by Reduction to Nitric Oxide, and Re-Transformation into Nitric Acid.*

This reaction was first applied by Schlösing to the determination of nitric acid.

1. *Method of Schlœsing.*—The water under examination is concentrated to a small bulk in a flask fitted with an escape-tube, and every trace of air expelled out of the apparatus. After stopping up the tube, it is allowed to cool, and by aid of the vacuum thus produced within, first a strong solution of protochloride of iron, and afterwards traces of concentrated hydrochloric acid, are drawn up into the flask. The nitric oxide produced by their action is expelled by a gradual rise of temperature, and received in a cylindrical glass vessel drawn out to a point, which has been previously filled with mercury and a little milk of lime, and inverted over mercury. As soon as all nitric oxide has been driven over, water is heated for some time to a boil in a second flask, likewise provided with a delivery-tube of caoutchouc. This tube is pushed over the point of the glass cylinder, the flame removed, the point broken, and the nitric oxide is allowed to pass over into the flask. After the last traces of this glass have been driven out of the collecting-receiver by a current of pure hydrogen, which is transferred to the flask in a similar manner, the latter is allowed to absorb pure oxygen as long as red fumes are produced. The caoutchouc tube, and consequently the flask, is closed by a pinchcock, and, after the lapse of twenty minutes, the nitric acid, reproduced by means of the nitric oxide, oxygen, and water, is titrated with dilute soda-lye. This process is considered accurate according to the unanimous report of the most experienced analysts. It requires, however, great skill and appliances not always procurable.

Reichardt, after he had satisfied himself that the portions of the nitric oxide absorbed by soda-lye were imperceptibly small and might be safely neglected, replaced the mercury by a solution of soda. He provides the gas-developing vessel with a stopper pierced with two holes, through which pass two bent glass tubes with caoutchouc connectors and pinchcocks—one for the admission of the chloride of iron and hydrochloric acid, and the other to connect with the soda-receiver and to deliver the nitric oxide generated. The receiver consists of two tall narrow bottles, the first of which has a stopper with a triple perforation, and is completely filled with soda-lye. The nitric oxide is received in the upper part of this bottle. Through two of the holes in the stopper pass bent fine glass tubes, the first of which is connected in the course of the operation with the delivery-tube of the generating-flask; the second forms the communication between the soda-lye in the collecting-bottle with that in the second narrow bottle. These two tubes pass down nearly to the bottom of the bottle. A slightly bent glass tube in the third perforation is cut off level with the bottom of the cork, is provided with an india-rubber closure, and serves to transmit the disengaged nitric oxide into Schlösing's regenerating-bottle. This process is much employed, and is very convenient; but the results are slightly below the truth. 10 to 15 c.c. of an almost saturated solution of protochloride of iron are enough for 1 to 40 milligrms. of nitric acid.

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* Abstract of a Paper from *Ber. d. Deut. Chem. Ges. zu Berlin.*

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,

Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

In accordance with the request of the Editor of the Chemical News, I have undertaken the compilation of a series of articles on the detection and estimation of adulteration of food, &c., regarded more especially from a chemical point of view.

The microscopical examination of food has been dealt with so fully by Hassall, and by Mr. Bell in his recent lecture before the Chemical Society, that there is no occasion to enter into the matter again, especially as the microscopic appearance of substances is not liable to change or improvement, like the chemical processes for their detection and estimation.

The very great want of definite knowledge on the subject, and of a more systematic method of procedure, has doubtless been the cause of some of the recent lamentable discrepancies in the results of public analysts, and there seems to be a demand on the part of many chemists for further information respecting the processes adopted by their fellow analysts.

In the following articles I propose to give, in a condensed form, the results of previous workers, and in some instances to supplement these by the conclusions derived from my own observation and experience. Of course the articles must be largely compiled from former papers, but it is hoped that they will be found more useful and convenient than a continual reference to the originals.

I. *Coffee and Chicory.*

Coffee and chicory can be conveniently considered together, as their adulterations are to a great extent similar, and the frequency of their admixture renders it difficult to treat of either without reference to the other.

It is a very prevalent idea that the admixture of chicory with coffee is a decided improvement, and *de gustibus non est disputandum*; but the low price of chicory as compared with coffee is a strong temptation to increase the proportion of chicory to an undue extent. Certainly, the unacknowledged addition of chicory to coffee must be considered an adulteration, but there can be no objection to the mixture being sold, provided the purchaser does not purchase it for pure coffee.

Chicory (*Cychorium intybus*) belongs to an entirely different botanical order from coffee, being closely allied to *Taraxacum* (dandelion), which it resembles in its therapeutic effects. Chicory is entirely destitute of the alkaloid caffeine of caffeic acid, and of the essential and fixed oil contained in coffee (a little fat is added to chicory during the process of roasting), and appears to possess no stimulating or other valuable dietetic properties.

The infusion of coffee is brown, but perfectly clear, and strikingly different in appearance from that given by chicory, which is turbid and of a disagreeable bitter flavour. It seems probable that coffee drinkers, who like the dark colour and bitter taste which an admixture of chicory imparts, might obtain the same results in a cheaper, and possibly healthier, way, by using burnt sugar, which is said to be sold to coffee dealers and coffee-house keepers under the name of "black-jack."

Good coffee is not hygroscopic, while chicory is highly so, and mixtures containing it show the same character more or less. Squeezed between the fingers, genuine coffee does not cohere, but mixtures containing chicory usually cake together. When moistened with water the grains of coffee remain hard for a considerable time, while the usual adulterants soften immediately.

A *preliminary examination* of coffee for admixture is best made by gently strewing the powder upon the surface of cold water. The oil contained in coffee prevents the particles from being readily wetted by the water, thus causing them to float. Chicory, burnt sugar, &c., contain no oil, and their caramel is very quickly extracted by the water, with production of a brown colour, while the particles themselves rapidly sink to the bottom of the water.[*] On stirring the liquid, coffee becomes tolerably uniformly diffused without sensibly colouring the water, while chicory and other sweet roots quickly give a dark brown turbid infusion. Roasted cereals do not give so distinct a colour.

Under the microscope, the presence of chicory is readily recognised by the peculiar dotted character of the vessels, often occurring in bundles, and by the characteristic appearance of the large cells. The presence of burnt sugar is best recognised by moistening the sample with water and observing it with a low power. If the brown colouration appears to be concentrated round small, dark-coloured, hard, shiny particles, the presence of extraneous caramel may be considered certain. Chicory and other roasted sweet roots contain caramel as a normal constituent, so the chemical tests are valueless for indicating its origin.

If roasted cereals or leguminous seeds be present, the starch corpuscles will still be recognisable, though often so altered as to render it impossible to determine the kind of seed from which they were derived.

The microscope affords an efficient means of detecting most of the adulterants of coffee and chicory, but for their estimation recourse must be had to other means, and even these are not very satisfactory, the determinations possible by known methods amounting at best to mere approximations.

According to Messrs. Graham, Stenhouse, and Campbell,[†] the proportion of sugar existing in raw and roasted coffee-berries is:—

	Sugar, per cent.	
	Raw.	Roasted.
Highest amount	7·78	1·14
Lowest amount	5·70	—
Average of twelve specimens grown in different places	6·97	0·26

The sugar in the raw berries is cane sugar, but it appears to exist in some peculiar state of combination, as it does not yield caramel by the roasting of the berries.

The percentage of sugar in chicory and other sweet roots has also been determined by the above chemists (by fermentation). (See table at top of next column).

Messrs. Graham, Stenhouse, and Campbell found that the depth of colour of the liquid obtained by infusing coffee and its usual adulterants in 2000 times their weight of boiling-water varied remarkably, caramel giving about seven times, and chicory about three times, as deep a colour as coffee. The test, in my opinion, is of but limited value, as coffee itself gives a brown colour, and therefore

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[*] If a separating funnel be used for the above test, the chicory, &c. may be readily let out at the lower end and examined separately under the microscope.

[†] *Journ. Chem. Soc.*, 1857, p. 33.

	Sugar, per cent.	
	Raw.	Roasted.
Foreign chicory	23·76	11·98
Guernsey "	30·49	15·96
English "	35·23	17·98
" " (Yorkshire)	32·06	9·86
Mangold-wurzel	23·68	9·96
Carrots (ordinary)	31·98	11·53
Turnips	30·48	9·65
Beet-root (red)	24·06	17·24
Dandelion-root	21·96	9·08
Parsnips	21·70	6·98

a moderate adulteration cannot be detected, especially as different samples of coffee were found to vary between 183 and 143 in tinctorial power, as compared with caramel at 1000.

Caramel itself is not a definite substance, and different samples vary much in tinctorial power.

Messrs. Graham, Stenhouse, and Campbell found the density of infusions of coffee and its adulterants a valuable criterion. The solutions were made by treating the powder of the roasted substance with ten times its weight of cold water, and then raising the liquid to the boiling-point and filtering through paper, when the infusions had the following densities at 60° F.

Spent tan	1002·14
Lupin-seed	1005·70
Acorns	1007·30
Peas	1007·30
Mocha coffee	1008·00
Beans	1008·40
Neilgherry coffee	1008·40
Plantation Ceylon coffee	1008·70
Java coffee	1008·70
Jamaica coffee	1008·70
Costa Rica coffee	1009·00
" " " ..	1009·05
Native Ceylon coffee ..	1009·00
Brown malt	1010·90
Parsnips	1014·30
Carrots	1017·10
Bouka..	1018·50
Yorkshire chicory	1019·10
Black malt	1021·20
Turnips	1021·40
Rye-meal	1021·60
English chicory	1021·70
Dandelion-root..	1021·90
Red beet	1022·10
Foreign chicory	1022·60
Guernsey chicory	1023·20
Mangold wurzel	1023·50
Maize..	1025·30
Bread raspings..	1026·30

This test furnishes valuable confirmatory evidence of the presence and probable proportion of sweet roots and cereals, but does not allow of the recognition of the leguminous seeds.

Neither chicory nor coffee contains starch, so, if any be present, it shows an admixture with some cereal or leguminous seed. If the sample be boiled with water and animal charcoal, starch may readily be detected in the cold filtered solution by the well-known blue colouration with solution of iodine.

Of course, the particular seed which has been added to the sample can only be ascertained with certainty when the process of roasting has left the microscopic characters of the starch almost unchanged, but when the adulteration is extensive valuable confirmatory evidence is afforded by the composition of the ash, as pointed out by Messrs. Graham, Stenhouse, and Campbell in the paper already referred to.

The percentage of ash yielded by genuine coffee should not exceed 4·5 per cent, and chicory should not give more than 5·0 per cent of ash, and any proportion considerably in excess of these numbers may be regarded as indicating adulteration by mineral matter. If red ochre, Venetian red, or other ferruginous matter be present, the ash will have a reddish colour. The oxide of iron natural to coffee never reaches 1 per cent of the weight of the ash, and in chicory ash it varies from 3 to over 5 per cent.

The ash of coffee is remarkable for its almost complete freedom from silica, so that, even if 1 per cent of the ash remains insoluble in boiling hydrochloric acid, it is a proof of adulteration. Chicory ash, on the other hand, contains a large and very variable amount of silica, varying from 10 to 36 per cent of its weight. A considerable proportion of this exists in the form of actual sand; this will be left insoluble on treatment of the ash with hydrochloric acid, but, to render the whole of the silica insoluble, evaporation of the acid liquid to dryness, and re-solution, must be resorted to. Iron can be conveniently determined in the filtrate by one of the volumetric methods. A considerable quantity of the sample should be taken when it is intended to make these estimations.

Some years ago imitation coffee berries were manufactured of Stourbridge clay; these were mixed with the genuine berries, and roasted with them, when they absorbed some of the colouring matter and oil, and so remained a close imitation. On breaking such spurious berries, the colour would be seen to be principally on the exterior. Of course the fraud would be at once detected on the estimation of the ash and its contained silica.

In 1850, Messrs. Duckworth, of Liverpool, took out patent for moulding chicory into the form of berries.

As a rule I should recommend the use of the following method of examining coffee and chicory, the first three tests being always applied, and the others when further information is required:—

1. The cold-water test.
2. Examination of the sediment in cold water, and of the original sample, under the microscope.
3. Estimation of the ash and, if necessary, of its contained silica and iron.
4. Determination of the density of the aqueous infusion.
5. Ebullition of the sample with water and animal charcoal, and application of the iodine-test for starch to the filtered liquid when cold.

(To be continued).

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Ordinary Meeting, January 29th, 1874.

Dr. Lunge, President, in the Chair.

The President said, before proceeding to the business of the evening, he might read the following account, translated from a German newspaper of undoubted reliability:—

"In the Silesian village Lazisk, near Nicolai (county of Oppeln), the other day the following fearful accident took place. In a public-house there were sitting, among other visitors, several miners and a gamekeeper. The miners had just come from their work, and had still their leather satchels slung from their shoulders, in which they used to keep their smaller tools. Suddenly the gamekeeper observes smoke issuing from the satchel of one of the men, and whilst he stretches out his hand for it, to ascertain the cause, something explodes within the satchel with a tremendous noise. The miner is torn in several pieces; some parts of his body are hurled through the shattered ceiling, and the whole house is almost demolished. Most other persons present at the accident were more or less hurt. The before-mentioned gamekeeper lost an arm, and was so much injured that he died after a few days. The cause of the accident was found in this—that the miner had put in his pocket eight dynamite cartridges prepared for blasting, and had put beside them his tobacco pipe, which was not quite smoked out, the spark of fire still present in the tobacco causing the explosion."*

Mr. Pattinson said from his own experience he should very much doubt the freedom from stythe referred to by Mr. Berkley, and he was confirmed in this by a gentleman who had had considerable experience in the use of dynamite. He had also had the details of a recent fatal accident in Wales from the same gentleman, which threw some doubt on its great safety.

Mr. Lomas offered a few remarks on the advantages of dynamite, and promised a more detailed communication at the next meeting.

Mr. Freire-Marreco exhibited and described a series of slides illustrating the examination by polarised light of bees'-wax and its various adulterants.†

NOTICES OF BOOKS.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and J. Braithwaite, M.D. Vol. lxviii., July to December, 1873. London: Simpkin and Marshall.

The half-yearly volume before us, in addition to its usual survey of the progress of medical science, contains several articles no less interesting to chemists than to physicians.

The papers "On Sewage and Disease," "On a Pure Water Supply," "On the Dangers of Well-Water," the "Report of the Analytical Sanitary Commission on Disinfectants," "On the Dissemination of Zymotic Disease by Milk," "On the Origin of Typhoid by Infected Milk," and "On the Affectable and Infectable Susceptibility of Milk" enter deeply into questions which have been seriously debated this season, both in professional and non-professional circles, and on which we are far from having reached a satisfactory conclusion. To some of the above-cited papers we may, space permitting, take occasion to return.

Elementary Inorganic Chemistry: The Non-Metallic Elements. By Raphael Meldola, F.C.S. London: Thomas Murby.

This volume belongs to "Murby's Science and Art Department series of Text-Books," edited by S. B. J. Skertchley, F.G.S. The author is described as of the Royal College of Chemistry and Science Training Schools, South Kensington. To say on elementary inorganic chemistry, within the compass of some 180 pages, anything at once novel, true, and important is not easy. The author, to do him justice, does not make the attempt. His object is distinctly stated. "This book, he tells us, "makes no pretence to teach practical chemistry, but is intended rather as a companion to the student when attending the course of demonstrations prescribed by Dr. Frankland for the science classes undergoing preparation for the May examinations of the Science and Art Department." In other words, his object is to teach, not so much chemistry, as those views of chemistry which are at present in the ascendant at South Kensington. Let no one infer that we under-value the work on this account. We may, indeed, think art too long and life too short for a nomenclature of which "tetra-hydrogen calcium diphosphate" is a specimen; we may hold that, if a "graphic formula is nothing more than an artificial epitome of the reactions of a compound," the "epitome" is far harder to remember than a detailed statement of the facts. Still, so long as a knowledge of such nomenclature and such formulæ is exacted from the student as an imperative condition, books like the one before us are needed, and must be carefully studied.

CORRESPONDENCE.

GREEN'S FUEL ECONOMISER.

To the Editor of the Chemical News.

Sir,—On perusing your Chemical News, vol. xxix., p. 69, we observe an article relating to "Fuel Economisers" now being exhibited at Manchester (Peel-Parke), and wish to draw your special attention to a paragraph in reference to our fuel economiser, which is as follows:—"There is one serious objection—that is, if a pipe in the centre burst, it is not easy to get at it, and to replace it often involves a loss of several days." This we consider is a matter of great importance, and we think it only right and just, in order to protect our own interest, to state that our apparatus is so arranged that we can not only draw the centre pipe, but also any pipe that may require to be drawn, and replace it in a couple of hours without disturbing the brickwork, and not necessitating a loss of several days as you imagine. Moreover, we may state that ours is the only apparatus where this provision is made. We take the liberty of handing you one of our prospectuses, in which you will see a diagram showing a pipe partly drawn out.—We are, &c.,

Edward Green and Son.

Phœnix Works, Wakefield,
March 12, 1874.

PINK AND WEBSTER'S "ANALYTICAL CHEMISTRY."

To the Editor of the Chemical News.

Sir,—A comparison of A. G. P.'s critique on this book in Chemical News, vol. xxix., p. 90, with the reply (p. 120) of Mr. Webster, will show that the latter has found fault with the trivial inaccuracies of his critic, but has neglected to answer, or even to understand, the real accusation brought against him. It is scarcely necessary to point this out to your readers, but perhaps you will allow me to state that a somewhat lengthy correspondence with Messrs. Pink and Webster has convinced me of their utter inability to admit themselves mistaken. A. G. P. may rest assured that the utmost he can achieve will be to draw from these two gentlemen a collection of letters of no earthly use except to raise a smile. Unfortunately there is a serious side to the subject. Some wretched students are certain to assimilate Pink and Webster's book, and will ultimately have to unlearn at least a portion of what they have learnt. That the book is lamentably deficient will be acknowledged by all who read it, except the authors; even they may see, though they may not confess, that a student examining so common a salt as hyposulphite of soda as an unknown substance could not possibly ascertain what it was if he worked only according to their instructions. This single instance shows the incompleteness of the book. As a specimen of its positive errors, look at the following extract from page 71:—

"Examination for the Inorganic Acids.

"To a neutral solution add $BaCl_2$, and cover the end of the test-tube with a watch-glass. . . .

"Watch-glass becomes corroded—Presence of HF. . .

"Effervescence takes place—Indicating Presence of $COHO_2$."

For the present this is quite enough.—I am, &c.,

Geo. Chaloner.

Birkbeck Institution
March 16, 1874.

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* The journals of Bourdeaux state that the manufactory of dynamite at St. Medard-en-Julle has just been completely destroyed by an explosion, the third that has taken place since its foundation, no trace of the workshops remaining. (*Am. Chem.*, iv., 280, Jan., 1874.)

† A compound eye-piece of selenite and tourmaline was employed, but the appearances can hardly be described without engravings, which it is not considered worth while to give, as the experiments are only preliminary.

ARTIFICIAL INDIGO.

To the Editor of the Chemical News.

SIR,—I notice with interest a communication (CHEMICAL NEWS, vol. xxix., p. 110) by Dr. Phipson on the probable production of indigo from phenol-cyanine, and as I have for many years been interested in this subject, but too much engaged to follow it out carefully, perhaps you will allow me to reproduce in your journal a few remarks which I made in a paper read before the recent Pharmaceutical Conference at Bradford, and which resulted from facts observed during many years in the manufacture of ammoniacal salts, &c., from crude gas-liquor.

Referring to the various impurities found in gas-liquor, I remarked some of these principles have acid qualities, and adhere with such tenacity to the volatile alkali of the gas-liquor that they cannot be separated from it either by oxidation, distillation, or by detergent agents. For instance, we may separate the sulphur by a hydrated metallic oxide, then treat the filtrate with permanganate, and distil it two or three times, and we shall get a product sweet and brilliant; but, after standing a month in a white glass bottle, a deep indigo-blue deposit forms on the glass.

Twenty years ago I formed the opinion that this deposit is a true indigo resulting from a re-arrangement of the elements of the gas-tar and the ammonia, and subsequent discoveries as to the constituents of gas-tar confirm the impression. Note, for instance, the composition of phlorylic acid, $C_8H_{10}O$, and ammonia, NH_3, and water, HO; may we not admit the probability of indigo resulting thus?—

$$\left.\begin{array}{l}\text{Phlorylic acid, } 2C_8H_{10}O\\ \text{Ammonia, } 2NH_3\\ \text{Water, } 2HO\end{array}\right\} = \begin{array}{l}\text{Indigo, } C_{16}H_{10}N_2O_3\text{, and } H_{18}\\ \text{(evolved slowly during forma-}\\ \text{tion of blue deposit).}\end{array}$$

The tendency to form this blue deposit renders such liquor ammoniæ unfit for pharmaceutical and some other purposes.

I shall be interested in any comments which these observations may elicit.—I am, &c.,

ALFRED PAYNE, F.C.S.

Ettingshall, Wolverhampton,
March 11, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 26, 1874.

Acetylen Liquefied and Solidified by means of the Electric Effluvia.—MM. Thenard.—The gas condensed very rapidly, 4 to 5 c.c. in a minute, appearing on the interior surface as a solid body of vitreous or horny look, very hard, and with the colour of wine. It is refractory to all solvents, even fuming nitric acid. It gave on analysis the elementary formula of gaseous acetylen.

Experimental Researches on the Coloured Rings of Newton.—M. Desains.—The lens is fixed, and the plane is moved by means of a micrometric screw, the thread of which is half a millimetre. The angular movement required to bring sixty consecutive rings into the central spot is 12·85°, and R is deduced =0·000594 m.m., the light being that from a saline gas.

Direct Demonstration of the Equation $\int \frac{dQ}{T} = 0$ for every Cycle, Closed and Reversible.—M. Ledieu.—A thermo-dynamical paper.

M. Poncelet's Course of Applied Mechanics.—Gen. Morin.

Observations by Prof. Nordenskjöld in the Polar Regions.—(Continued).—This letter treats of the carbonaceous dust, along with metallic iron, found falling in these regions, the vast glaciers explored, and beds of fossil plants. The writer finds that the transformation of snow into ice shows an intermediate state in which the snow layer is changed into one of ice-crystals, forming hexagonal tables (like crystals of colourless apatite). A section of the lower part of a glacier presents the following layers.—(*a*) A layer of snow of varying thickness, consisting of very small detached grains rounded by friction against each other, and carried about with the least wind. (*b*) A more solid layer of small grains changed below into (*c*) a layer consisting almost exclusively of crystals; at the lower part of this layer the crystals are rounded more and more, and transformed gradually into (*d*) a layer of large round grains of small weight. The true ice is formed by compression of these grains. In the upper part it is very porous, but it becomes more and more solid.

Note on Magnetism.—M. Gaugain.—After noticing M. Jamin's observations on the distribution of magnetism in a soft iron bar having bobbins round its two extremities, the author recurs to the phenomena produced by detachment of an armature. He finds that the magnetisation obtained by means of a current of certain intensity may be increased by a current in the contrary direction. His procedure is as follows:—He passes a current of intensity +I into the bobbins of an electro-magnet furnished with its armature, interrupts the current without detaching armature, passes a current in the opposite direction and of less intensity, −*i*, interrupts this current, detaches armature, then applies and detaches a number of times sufficient to bring the magnetism to the constant state. After this process the permanent magnetisation of the bar is found much stronger than if the current +I circulated alone in the electro-magnet. The author theorises on this and some other related effects.

Theory of Flight of Birds.—MM. Planavergne. (Extract.)—The authors state with reference to M. Marey's recent communication that they had already formulated the same principle, and they cite a passage proving this.

Certain Reactions of the Oxygen Compounds of Nitrogen.—M. Berthelot.—A thermo-chemical paper, unsuitable for abstraction.

Rupture of Magnetised Needles.—M. Bouty.—If a magnetic needle of recently hardened steel be broken through the middle one of two cases may occur. (1) If the needle is hardened sufficiently to break in the fingers like glass, the two halves are magnets of the same magnetic moment. (2) If the needle is softer, so that it bends several times before breaking, the two halves have unequal magnetic moment, and in a manner seemingly arbitrary. The following experiments were made with regard to this:—A regular steel needle, slightly hardened, is seized to the middle between two lead plates, the free extremity being grasped, is bent to and fro repeatedly till rupture; and the half thus bent is found to have less magnetic moment than the other half. Again, if one seize a similar needle with two pincers, at points very near its middle, and equally distant from it, the two halves after rupture have equal magnetic moments. It is concluded that rupture does not produce proper magnetic effect independent of the effect of separation, pure and simple, of the parts; at least so long as it is not accompanied by flexions involving a finite portion of the ruptured needle. This conclusion was subsequently confirmed. The author considers—first, rupture of saturated cylindrical needles perpendicular to the axis; then rupture of cylindrical unsaturated needles, regular, or presenting consecutive points; and, lastly, rupture of saturated needles parallel to the axis. He remarks that this rupture of a needle is, perhaps, one of the most delicate methods for ascertaining its regularity. On the third point it is stated that the sum of the magnetic moments of the separated steel laminæ of a magnetic bundle is considerably higher than the moment of the bundle. This is explained by consideration of the two kinds of magnetism, temporary and permanent, of which steel is susceptible.

Pluvial Régime of the Torrid Zone in the Basins of the Indian and Pacific Oceans.—M. Raulin.—*En resumé*, in the torrid zone the differences of mean monthly temperatures, which are far from being so great as in the temperate zones, seem yet to have a considerable influence on the rainfall. To the north of a line, which sometimes coincides with the equator and sometimes rises more or less to the north, rain (often very abundant) falls especially in April and September, that is during the half-yearly hot period of the northern hemisphere. South of this region it especially falls during the other half-year period, October to March, which is the hot period of the southern hemisphere.

Note apropos of New Experiments by Professor Tyndall on the Acoustic Transparency of the Air.—M. de Fonvielle.—If moist air does not readily extinguish either acute or grave sounds, one does not see how it will facilitate the propagation of the former to exclusion of others. The sounds of a steam-whistle are not the only ones which strike the ear of aëronauts above the sea of clouds. They hear others, always very acute, but sometimes of considerably less intensity. The author supposes that the envelope of the balloon, tensely stretched by the gas, acts as a membrane, enabling one to hear certain sounds which, though very weak, have been able to pass through the clouds. He asks whether the sails of the yacht in which Prof. Tyndall sailed may not have produced an effect of this nature. He considers that aëronautic observations are the best calculated to throw light on this substance, so important to marine navigation.

Production of Yeast in a Saccharine Mineral Medium.—M. L. Pasteur.—The author has formerly shown that no ammonia is formed during alcoholic fermentation as was formerly assumed. He considers it established that alcoholic yeast can multiply in an aqueous solution of pure sugar, with an ammoniacal salt and the ash of yeast, or alkaline and earthy phosphates, including those of magnesia and of potash. This he regards as the first proof that the albumenoid matters of certain living beings may be formed by sugar and ammonia with mineral phosphates and sulphates without the aid of light and of "green matter." Yeast which has germinated in a mineral medium becomes more suited to multiply in a similar medium. It has become acclimatised.

Reply to M. Pasteur Concerning the Transformation of the Yeast of Beer into Penicillium Glaucum.—M. A. Trecul.—Another stage of the interminable Pasteur controversy.

Presence of Nitre in two Varieties of Amaranthus.—M. A. Boutin.—*Amaranthus ruber*, dried at 100° C., contains 16 per cent of nitrate of potash, which amounts to 22 grms. of nitrogen and 72 grms. of potash per kilo. of the dried plant. *Amaranthus atropurpureus* is still richer, containing 22·77 per cent nitrate of potash. It is probable that in their native country, India, these plants will be still richer in nitre.

On Certain Points Relating to the Efflorescence of the Two Hydrates Formed by the Sulphate of Soda.—M. D. Gernez.—The author maintains that the facts from which Coppet infers the existence of two isomeric modifications of the anhydrous sulphate of soda are not novel. He pointed out, in 1865, that effloresced sodic sulphate always causes a supersaturated solution of the salt to crystallise, whilst the sulphate dehydrated by heat does not induce crystallisation. Coppet infers from his experiments that there are two isomeric modifications of anhydrous sulphate of soda, one recognised by all chemists and produced above 33°, and one which, according to him, is obtained by drying ordinary sulphate of soda below that temperature. Gernez denies that the experiments of Coppet lead to this conclusion, and considers the fact of the co-existence of two hydrates in one and the same liquid at the same temperature of great importance towards deciding the state in which bodies exist in their solutions.

Reaction of Chloride of Silver with Biniodide of Phosphorus.—A. Gautier.—50 grms. of pure biniodide of phosphorus were pulverised in a current of dry air, placed in a flask, and mixed with 60 grms. of dry chloride of silver. The reaction begins in the cold, and if the mixture is gently heated a colourless liquid distils over, which boils at 76° to 78°. This liquid is trichloride of phosphorus. If the heat is raised to 280° C. free phosphorus sublimes, whilst in the flask remain iodide of silver mixed with an excess of chloride, and of amorphous phosphorus. It is remarkable that in this reaction 2 equivalents of iodine are replaced by 3 of chlorine. The chloride of silver liberates at a low temperature a part of the phosphorus of the biniodide—a singular reaction.

Isomerism of Terebenthen and Tereben from a Physical Point of View.—M. J. Ribau.—A paper unsuitable for abstraction.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 3, February 5, 1874.

At a meeting of the Society, January 2, M. Berthelot discoursed on the titration of permanganate of potash solutions, and maintained that oxalic acid was the only trustworthy reagent.

M. D. Tommasi, by acting upon camphor with chloride of benzyl in presence of a small quantity of zinc-powder, has obtained a series of seven hydrocarbons, whose boiling-points range from 108° to 203°.

MM. Meldola and Tommasi have prepared phenyltrichloracetamide, $C_8H_6Cl_3ON$, by the action of aniline on the chloride of trichloracetyl. It is a compound insoluble in water, soluble in alcohol, and fusible at 94·5°. Fuming nitric acid converts it into a nitro derivative, crystallising in fine yellow needles.

M. Friedel discusses the formula assigned by Boutlerow to pinacoline.

Researches on the Oxides of Nitrogen, their Stability, and their Reciprocal Transformations.—M. Berthelot.—We have already noticed this paper.

Synthesis of Oxyl-urea (Parabanic Acid).—M. E. Grimaux.—This paper has been also already noticed.

Solubility of Succinic Acid in Water.—M. E. Bourgoin.—It is generally stated in chemical text-books that succinic acid dissolves in five times its weight of cold water. The author finds that at 0° water takes up 2·88 per cent of succinic acid; at 27°, 8·11; at 48°, 20·28; at 78°, 60·75; and at 100°, 120·86.

Metallurgic Treatment of the Bismuth Ore of Meymac.—M. A. Carnot.—One only of the bismuthic minerals of Meymac, the hydrocarbonate, is found in quantity sufficient for practical purposes. It has doubtless been formed by the action of water upon the sulphide, which will, therefore, be found at greater depths. The pounded ore is attacked by hydrochloric acid. The undissolved residue is twice subjected to the same treatment until exhausted, when it contains no appreciable proportion of bismuth. The solution is filtered, and iron is introduced, on which the whole of the bismuth is deposited as a heavy black powder. The solution is drawn off before the iron it contains has time to become oxidised and produce a deposit. The precipitate is washed in pure water, pressed in linen bags, and dried rapidly in a stove. It is then filled into black-lead crucibles, which are covered with coarse charcoal-powder, and heated gradually in a calcination furnace for forty-five minutes without exceeding redness. The bismuth is then run into ingot moulds, and is ready for sale.

Compounds of Thorium.—M. Cleve.—An important paper. The author has examined and described the oxide, normal hydrate, chloride, potassio-chloride, chloroplatinate, silico-fluoride, platino-cyanide, ferro-cyanide sulpho-cyanide; nitrate, per-chlorate, chlorate, bromate, and iodate; carbonate of thorium and sodium; two sulphates; sulphate of sodium and thorium; sulphate of ammonium and thorium; sulphite; hyposulphate; seleniate; selenite; two orthophosphates; pyrophosphate; pyrophosphate of thorium and sodium; formiate, acetate, oxalate; oxalate of thorium and potassium; tartrate; tartrate of thorium and potassium. Thorium is not isomorphous with any element.

On Koussine.—M. C. Bedall.—Koussine, the active principle of kousso, is found, not merely in the flowers, but also in the stalks and leaves. It is sparingly soluble in water, but readily in alcohol, the ethers, and the alkalies; its composition is $C_{26}H_{22},O_5$.

Determination of Sulphur in Cast-Iron, Wrought-Iron, and Steel.—M. Koppmayer.—10 grammes of iron, finely-powdered and sifted, are introduced into a bottle holding from ¼ to ½ litre. The stopper has three holes. Through one of these passes a funnel with a ground-glass tap, its neck reaching to the bottom of the bottle. Through the second passes the tube at right angles, fitted with a tap, and reaching also to the bottom of the bottle. Through the third hole passes a delivery-tube, connecting the bottle to the condensing apparatus. This latter consists of a series of bulbs arranged like a staircase, so as to permit the gas to come into the greatest possible contact with the standard solution of iodine in iodide of potassium with which the condenser is filled. This solution ought not to be exposed to light. When the apparatus is arranged as above, the atmospheric air is first driven out of the bottle by means of a current of hydrogen gas introduced by the tube bent at right angles. When it is considered that the air is entirely expelled the tap of this tube is closed. The funnel is now filled with hydrochloric acid, its tap is opened, and by means of the application of heat the acid is allowed to run down upon the iron without allowing any common air to enter. Hydrogen and sulphuretted hydrogen are formed, which pass into the condenser. Acid is thus added until all disengagement of gas ceases. The bottle is then heated until its contents boil, a little water having been first added by means of the funnel. After these operations hydrogen is allowed to enter anew to sweep out all remaining gases. The iodised solution is then poured out, care being taken to rinse the bulb-tube thoroughly, and titrated with hyposulphite of soda, so as to find the remaining proportion of free iodine. The difference between the original amount of iodine present in the solution and the amount thus found, shows the proportion of iodine which has been converted into hydriodic acid, and which is proportional to the sulphur contained in the sample under examination.

On Moistened Coal.—Ferd. Fisher.—The author shows by a calculation of the heat disengaged that by moistening coal we lose both in the quantity of heat and in the temperature attained.

Carbonisation of Wood in Closed Vessels.—M. von Reichenbach.—The charcoal obtained in retorts can be more abundant or of better quality than that prepared in stacks. The dimensions of the retorts affect the quality of the charcoal. In small retorts, where the carbonisation is rapid, a light and porous charcoal is obtained. In furnaces the carbonisation is slow, and the charcoal produced yields neither in weight nor in density to the best obtained by the ordinary process. When wood is distilled slowly, whether in retorts or in furnaces of masonry, the hygroscopic water is first expelled; then follows the pyroligneous acid, which falls in strength after having attained a maximum. Then come the tarry matters accompanied by combustible gases, after which the carbonisation is complete. If the distillation is stopped when the pyroligneous acid ceases coming over, the charcoal obtained is the so-called red charcoal. This imperfectly carbonised wood retains in a solid form, beside carbon, the bodies which by their decomposition yield the tars and gases, and it has parted with all its water and with the available acetic acid. This red charcoal yields as much heat in the metallurgical arts as black charcoal, and, moreover, it disengages gases which are useful in such cases, and which when charcoal is burned in stacks or clamps are wasted in the air. Wood may be considered as containing 40 per cent of carbon, 40 of combined water, and 20 of hygroscopic moisture. In complete charring, 100 kilos. of hard wood yield 20 kilos. of charcoal, 5 kilos. of tar, and 5 kilos. of acetic acid, besides the gas. In case of incomplete charring the products are acid, and red charcoal, which contains all the matters representing charcoal, tar, and gas. The weight of red charcoal exceeds by more than one-half that of the black charcoal from the same quantity of wood. Red charcoal is less brittle than black, and bears carriage better.

Action of Stannite of Sodium on Gun-Cotton.—M. R. Bœttger.—When well made gun-cotton is boiled for ten minutes with a concentrated solution of stannite of sodium there is formed a clear yellowish solution, which may be diluted with water without becoming turbid. The addition of hydrochloric acid precipitates regenerated cellulose. As cellulose itself is insoluble in the stannite of sodium, the above reaction may serve for the detection of unconverted cotton in samples of gun-cotton.

MISCELLANEOUS.

The Adulteration of Food Act, 1872.—Mr. Wentworth G. Scott has lately been appointed Analyst to the Borough of Hanley under the above Act. Mr. Scott already holds the same office in relation to the counties of Derby and North Staffordshire.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphate of soda. Thomas Nixon and Paul Quin, both of Hebburn, near Newcastle-on-Tyne. April 26, 1873.—No. 1522. In order to save the cost of the fire of the salt-cake furnace, we propose to utilise the waste heat of the ball-furnace, or other available furnace or pan, in such a manner that it will serve to complete the conversion of the salt-cake into sulphate of soda.

Improvements in the manufacture of white-lead and apparatus therefor. William Thompson, 101, Wandsworth Road, Surrey. April 28, 1873.—No. 1532. This invention relates to improvements in the process of and apparatus used in manufacturing white-lead. The melting-pan is made in compartments for regulating the temperature and securing the purity of the blue-lead. This lead is made into thin sheets of open texture by pouring it into a revolving cylinder kept cool, and it is granulated by running it in a thin stream between a roller and an inclined knife, and receiving it in water. The sheets and granules are charged on trucks, which are run upon rails into the chambers where the chemical reagents act on the lead so as to convert it into white-lead, the trucks charged with the converted lead being run out at opposite doors. The converting chambers are supplied with acid gases and vapours heated before their introduction in steam-jacketted pipes or vessels.

Improvements in the treatment of sewage, and in the manufacture of manure therefrom. Walter Brown, 30, Pulross Road, Stockwell, Surrey. April 29, 1873.—No. 1555. The features of novelty of this invention consist in treating sewage with the residue of blackstone, or other similar shaly mineral, after being calcined so as to fix the gases, and thus form a manure.

Improved apparatus for the manufacture of nitrate of soda. Cuthbert Russell, engineer, 2, Talbot Court, Gracechurch Street, London. (A communication from Robert Moore and Tomas Robert Williamson, both of Iquique, Peru, South America). April 29, 1873.—No. 1556. The features of novelty of this invention consist of closed cachucho or boiling-tank, fitted with perforated revolving cars, the arrangement and operations of which can only be understood by reference to the drawing accompanying the specification.

Improvements in the preparation and employment of indigo-blue dye. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Jerome Marble, Worcester, Massachusetts, U.S.A.). April 29, 1873.—No. 1557. The invention consists in dissolving indigo in a solution of lime, soda-ash, and muriate of tin crystals. To colour with this solution, clear water is heated to 120° Fahrenheit, and the solution added in quantities to produce the shade desired, bran being added to regulate the alkalies.

Improvements in the manufacture of explosive compounds. Alfred Vincent Newton, mechanical draughtsman, 66, Chancery Lane, Middlesex. (A communication from Alfred Nobel, Paris). April 30, 1873. —No. 1570. This invention consists in the use of paraffin, ozokerit, stearine, naphthalin, or any other fatty or sticky matter insoluble in water, as ingredients in explosive compounds containing nitrates, hygroscopic or not, and nitro-glycerin.

A new or improved process and furnace for the manufacture of metallic alloys. Alexander Browne, of the firm of Browne and Co., patent agents, 85, Gracechurch Street, London. (A communication from the Foundries and Forges Co., Terre Noire La Voulte and Bessegea, France). May 1, 1873.—No. 1574. The features of novelty of this invention as regards the process consist in mixing iron-filings, turnings, or granulated wrought-iron, cast-iron, or steel, or pulverised spongy iron, or any other scraps of cast-iron or steel in a nearly uniform state of division, and mixing them with ores containing manganese, tungsten, titanium, or any of these combined, or with quartz. The ores or quartz are finely pulverised, and mixed in sufficient quantities to form the required alloy. As regards the furnace, the novelty consists in constructing it as follows:—The furnace is composed of a cupola made of very hard fire-bricks containing a great quantity of alumina; the boshes are constructed of lime, magnesia, or pure alumina; the crucible or hearth is made of carbon, lime, or magnesia. The carbon crucible is made in one piece by moulding a mixture of pure graphite or gas-coal or pure coke with tar in a box made of strong sheet-iron, and heating the whole well closed up to a dark red heat for a few hours, a compact and very hard mass is thus obtained.

Improvements in the manufacture of Portland cement. John Ward, Battersea, Surrey. May 3, 1873.—No. 1599. This invention consists in the addition of a certain quantity of quick-lime to the liquid chalk and clay when passed from the wash-mill into a mixing-mill. The lime in the process of slaking absorbs a large quantity of the water from the liquid chalk and clay, leaving it sufficiently solid to go at once to the drying-stoves, and from thence to be burnt and ground in the ordinary manner. Running the liquid into backs or reservoirs is thus avoided, and a considerable saving of time and labour thereby effected, while the quality of the cement is improved.

Certain improvements in the manufacture of floor-cloths, roofing, and waterproof fabrics generally, some of the waterproofing material used in such improvements being also applicable as a varnish and cement, and for making solid materials, and coating ships' bottoms, and other rough purposes. Alexander Rollason, chemist, Totterdown, Bristol. May 5, 1873.—No. 1610. The first part of my invention consists in the use of limmer and such like rock asphalts, and reducing them to a state of liquefaction not by the use of bitumen, which has heretofore been used for that purpose, but by what is commercially known as crude paraphine or petroleum oil or other unpurified oils analogous thereto. The second part of my invention consists in dissolving animal products in water, such as glue, gelatin, albumin, and such like vegetable gums as will dissolve in water, as acacia, senegal, dextrin, and also starch, flour, and such like substances. The third part of my invention consists in mixing the before-named cotton waste with glue as described, or with animal products, linseed, or other drying oils or varnishes. Fourthly. I use the mixture of animal products and vegetable gums when mixed with bichromate of potash as described for the manufacture of solid substances, as buttons, knife handles, &c., which may be moulded or pressed into shape.

NOTES AND QUERIES.

Artificial Fruit Essences.—Can any of your readers inform me if any book exists giving particulars of manufacture of artificial fruit essences and of their composition, or kindly give me some information on the subject.—P. H. M.

Purifying Hydrochloric Acid.—Could you kindly inform me, through the medium of your valuable journal, by what process I shall be able to expel or precipitate arsenic acid from muriatic acid, commonly known as tower salts, produced at alkali works, without injuriously affecting the article.—J. S. O.

MEETINGS FOR THE WEEK.

Monday, March 23.—Medical, 8.
— London Institution, 4.
Tuesday, 24.—Royal Institution, 3. Prof. Tyndall, "On the Physical Properties of Liquids and Gases."
— Civil Engineers, 8.
— Anthropological, 8.
Wednesday, 25.—Society of Arts, 8. Lieut. H. H. Cole, R.E., "On the London International Exhibition of 1874."
— Geological, 8.
Thursday, 26.—Royal Institution, 3. Prof. W. C. Williamson, "On Cryptogamic Vegetation (Ferns and Mosses)."
— Royal, 8.30.
Friday, 27.—Royal Institution, 8; Weekly Evening Meeting. Prof. A. C. Ramsay, on "The Physical History of the Rhine," 9.
— Quekett Microscopical Club, 8.
Saturday, 28.—Royal Institution, 3. Mr. C. F. Newton, Keeper of Greek and Roman Antiquities, British Museum, "On Mr. Wood's Discoveries at Ephesus."

Sanitary Chemistry.—Dr. Medlock (late of Great Marlborough Street and Tavistock Square) undertakes the analysis of water, food, &c., and the scientific investigation of all matters relating to the public health.

Intending Investors in Chemical Patents may consult Dr. MEDLOCK by appointment. 26, CHARLES STREET, ST. JAMES'S, LONDON, S.W.

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Hours of Lecture for Session 1872-73:—

Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
(Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural) ..	11 a.m.	Classics (Junior)	9 a.m.
" (Systematic) ..	3 p.m.	" (Senior)	4 p.m.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 748.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 127).

The formula employed for the calculation of the true weight of a substance *in vacuo*, from data given by two weighings, one at ordinary and one at a greatly diminished air-pressure, is as follows:—

Let H denote the substance to be weighed, and h its true weight *(in vacuo)* in grains.

First Weighing in Air of Ordinary Density.

Let W denote the material weight which balances H,
w " " true weight of W observed in air,
x " " weight of air displaced by W,
t " " temperature,
p " " pressure, in height of mercury, reduced to 32° F.,
b " " bulk of W in grs. of water at max. density,
k " " weight of air displaced by H:
w, x, t, p, b being given, required to find k,

$$h-k=w-x.$$

Second Weighing in a Rare Atmosphere.

Let γ denote the weights which balance H,
y " " true weight of γ in air of ordinary density,
z " " weight of air displaced by γ,
t' " " temperature,
p' " " pressure, in height of mercury, reduced 32° F.,
$b'=\frac{y}{w}b$ " bulk of γ in grs. of water at max. density,
l denote the weight of air displaced by H:
y, t', p', b' being given, to find l and z,

$$h-l=y-z;$$

hence $k-l=y-w+x-z$.

By tables A and B,

$$\log.\ \frac{\text{density rare air}}{\text{max. den. water}}=$$
$$=\log.\ (p'-0{\cdot}378\,v_t)+\log.\ \frac{0{\cdot}001293893}{1+0{\cdot}003656}\cdot\frac{1}{760};$$

$$\therefore \log.\ b'+\log.\ \frac{\text{density rare air}}{\text{max. den. water}}=\log.\ z,$$

$$\frac{l}{k}=\frac{\text{density rare air}}{\text{density common air}}=n\ \text{(suppose)}.$$

Let $m=y-w+x-z$; then $k-l=m$, $\frac{l}{k}=n$.

Hence $l=nk$, $k-nk=m$, $k=\frac{m}{1-n}$, $l=\frac{mn}{1-n}$.

Hence $h=w-x+\frac{m}{1-n}$; or $h=y-z+\frac{mn}{1-n}$.

To illustrate the application of this formula, I will reduce the weighings of one of the determinations (E).

Substance weighed.	Balance used.	Weights, actual.	True value in air.	Weight of air displaced.	Temperature.	Bar. (reduced to 32° F).
(H)		(W)	(w)	(x)	(t)	(p)
Glass apparatus.	Vac.	765·8081	765·814578	0·044547 (vol. in water max. density = 36·326)	65° F. = 18·5° C.	29·848 (758·125 millims.)
(H)		(γ)	(y)		(t')	(p')
Glass apparatus.	Vac.	766·1133	766·122626	0·044546	63° F. = 17° C.	11·73 in. (29·79 millims.)

CALCULATION OF VACUUM-WEIGHT OF FLASK FROM ABOVE WEIGHINGS.

Let h = true weight in vacuum of flask,
w = 765·814578,
x = 0·044547,
t = 65° F. = 18·33° C.,
p = 29·848 in. = 758·12 millims.,
b = 36·326,
y = 766·122626,
t' = 63° F. = 17·2° C.,
p' = 1·173 in. = 29·79 millims.

$$\log.\ \frac{\text{den. atmos. air}}{\text{max. den. water}}=\log.\ 758{\cdot}12-4{\cdot}00+4{\cdot}204149-10;$$
$$\therefore\quad "\quad = 2{\cdot}8774430+4{\cdot}204149-10;$$
$$\therefore\quad "\quad = 7{\cdot}0815920-10.$$

log. b' = log. 766·122626 − log. 765·814578 + log. 36·326;
∴ b' = 2·8842970 − 2·8841230 + 1·5602176;
∴ b' = 1·5603916.

$$\log.\ \frac{\text{density rare air}}{\text{max. den. water}}=\log.\ (29{\cdot}79-3{\cdot}63)+4{\cdot}204898-10$$
$$\therefore\quad "\quad = 1{\cdot}4176377+4{\cdot}204898-10;$$
$$\therefore\quad "\quad = 5{\cdot}6225357-10.$$

log. z = 1·5603916 + 5·6225357 − 10;
∴ z = 7·1829373 − 10;
∴ z = 0·001524.

$$\log.\ \frac{l}{k}=5{\cdot}6225357-7{\cdot}0815920;$$
$$\therefore\quad \frac{l}{k}=8{\cdot}5409437-10;$$
$$\therefore\quad n=\frac{l}{k}=0{\cdot}034749;$$

∴ $1-n$ = 0·965251.
m = 766·122626 − 765·814578 + 0·044547 − 0·001524;
∴ m = 0·351071.

$$k=\frac{m}{1-n}=\frac{0{\cdot}351071}{0{\cdot}965251};$$

∴ k = 0·3638.
h = 765·814578 − 0·044547 + 0·3638;
∴ h = 766·133831.

WEIGHING OF GLASS APPARATUS + NITRATE OF THALLIUM.

Vacuum-Balance.

In air. Left pan removed. Platinum weights.

After third heating (to fusion) and cooling—

Weights.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
600	599·998340	0·035533	28·970
100	99·991420	5887	4·800
60	59·993232	3483	2·840
30	29·999991	1668	1·360
6	5·998268	355	·290
3	3·000469	171	·140
·06	0·061472	3	·003
·0031	0·003099	0	·000
799·0631	799·046291	0·047100	38·403
Pan = 206·3733	206·379646	0·012040	9·824
1005·4364	1005·425937	0·059140	48·227

Therm. = 73° F. = 22·7° C.
Barom. = 29·891 in. at 0° C. = 759·22 millims.

1005·425937
765·814578 = weight of glass apparatus (see w, preceding).

239·611359 = weight of thallium nitrate in air.

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* A Paper read before the Royal Society June 20, 1872.

The weight of air displaced, &c., is taken separately for each weight in all cases, but is omitted in subsequent examples (the sum being given), to prevent the introduction of useless figures.

WEIGHING OF GLASS APPARATUS + NITRATE OF THALLIUM IN RARE ATMOSPHERE.

Vacuum-Balance.

Exhausted. Left pan removed. Platinum weights.

Weights.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
799·3600	799·346792	0·047117	38·423
Pan = 206·3733	206·379646	0·012040	9·824
1005·7333	1005·726438	0·059157	48·247

Therm. = 69·5° F. = 21° C.
Barom. = 29·775 in. = 756·27 millims. at 0° C.
Gauge = 25·141 in. = 638·57 millims. at 0° C.

756·27
638·57

117·70 millims. pressure.

Weight of left scale-pan of air-balance, which was removed to relieve the beam in weighing the heavier pieces of apparatus—

Weight.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
179·7365	179·719377	0·010429	8·513

Weight of left scale-pan of vacuum-balance taken in air-balance—

Weight.	True value in air.	Weight of air displaced.	Vol. in water at max. den.
206·3733	206·3719646	0·012040	9·824

Weight of air displaced by scale-pan = 0·02403 gr.
Volume in water of maximum density = 24·244 grs.

(To be continued.)

ON THE

METHODS IN USE FOR DETERMINING THE VALUE OF VEGETABLE AND ANIMAL OILS.[*]

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland.

It is not easy to get at an accurate statement of the number of the fixed oils having a vegetable or animal origin, and which, having been examined or brought into use, have been found to differ from each other more or less in physical constitution or practical utility. Watts enumerates, in his "Dictionary of Chemistry," 49 vegetable oils, 11 fish oils, and 5 animal oils, making a total of 65. This list is defective, as it does not include some Indian products shown in the Exhibition of 1851, nor do we find the olein obtained from tallow alluded to.

Each of these fixed oils has some distinguishing characteristic. Possessing a general family likeness, no two are exactly alike.

Upon the possession or non-possession of certain valuable qualities esteemed by consumers of oil depend the practical applications of the oil, checked, however, from time to time by the relative scarcity or abundance of the oil; these two considerations establishing the market value. Accordingly we find, upon examining broker's circulars or Board of Trade returns for the last five or ten years, one particular class of oil, sperm oil, having an average yearly value of, in round numbers, £95 per ton; a second class, £60 per ton, represented by the animal oleins; a third class, £50 per ton, represented by the various qualities of olive oil; a fourth class, £40, represented by rape oils; a fifth class, £35 per ton, represented by the drying oils; and a sixth class, about the same price, represented by the stinking fish oils.

So great variations in price amongst the different classes enumerated show that they differ, for practical purposes, very much in utility, and we can scarcely suppose that the dealers in, and consumers of, oil, who have something considerably more than 100,000 tons, or 25,000,000 gallons, passing through their hands yearly, of the aggregate value of at least five or six million pounds sterling can preserve such class distinctions year after year without some solid basis which deserves the careful attention of the chemist. And these differences in the properties of the fixed oils is by no means always dependent upon the mucilaginous, albuminous, or odoriferous impurities they contain, but by actual differences in the properties, and perhaps constitution, of the olein, palmitin, or stearin, of which they are constituted, more especially, perhaps, in regard to their susceptibility of ready oxidation by atmospheric oxygen. The precise nature, however, of the variations in the proximate principles of oils is very little understood; indeed, if we had accurate knowledge on the matter, we might be able, perhaps, soon to boast of being able to make a commercial analysis of oil of some value.

As the matter now stands in reference to the detection of adulterations of animal or vegetable oils, all we can boast of are a few empirical tests, some of them of doubtful character, by which the absence of certain oils in mixtures can be sometimes inferred, and in a few cases the proportions in which they exist can be roughly guessed at.

When we consider the labour and perseverance required in order to get thoroughly acquainted with the individual characteristics of the chemical elements, it is obvious that to get similarly acquainted with the characteristics of the fatty oils, which are of greater number than those of the elements, is no light task. It is therefore proposed to point out in a subsequent part of this paper how, in the examination of commercial oils, we can much simplify our work by eliminating all such oils, as by reference to brokers' or merchants' circulars can be proved to be dearer than the supposed oil under examination. It may be taken as a commercial maxim that no man adulterates for the benefit of the public when it entails loss to his own pocket.

Before going further into this part of the subject we will review the chemical and physical tests which have been proposed for detecting adulteration in oils.

The most elaborate work in this direction was undertaken by the late Prof. Calvert, who studied the action of acids and alkalies in different states of dilution upon oils, and in special reference to the colour and appearance of the mass formed by combining 1 part of the reagent with 5 parts of oil at normal temperatures when the acids were used, and at boiling temperatures in case of the alkalies being used. The reagents used by Calvert were:—

1. Caustic soda of 1·340 sp. gr.
2. Sulphuric acid of 1·475 ,,
3. ,, ,, 1·530 ,,
4. ,, ,, 1·635 ,,
5. Nitric acid of 1·180 ,,
6. ,, ,, 1·220 ,,
7. ,, ,, 1·330 ,,
8. Product of No. 7 treated with twice its bulk of caustic soda and boiled.
9. Mixture of concentrated sulphuric and nitric acid.
10. Aqua regia.
11. The product of No. 10 treated with twice its bulk of caustic soda and boiled.
12. Syrupy phosphoric acid.

Calvert furnishes us with tables of results comprising 180 reactions, the observer to notice various shades of colour produced. The colours in a few cases, as in the reactions with fish-oils, are decided, but a large number of them appear to be of a very nondescript character, such as brownish, greenish, yellowish, dirty white, dirty green, slight yellow, &c. The observer has also to observe the fluidity or non-fluidity of the mass resulting from the action of caustic soda upon the oil.

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[*] Communicated to the Chemical Section of the Philosophical Society of Glasgow.

Now, on examining Calvert's tables, it will be observed that he only experimented with fifteen oils, those very important commercial oils, tallow olein and cotton-seed oil, being entirely omitted, besides fifty others of minor importance. It is sufficiently formidable having to study Calvert's 180 reactions, especially when we take into account the great prevalence of partial colour-blindness; but the task becomes very formidable if it becomes necessary to acquaint ourselves with the colours which would be produced in similar circumstances by the half-hundred or so of other oils not included, and which may probably give reactions which might be confused with those of the oils already examined.

Many of the colours produced may be owing to the presence of more or less mucilaginous matter, or small portions of the inspissated juices of the plant or animal, which really have no great bearing upon the genuineness of, or the adaptability of, the oil for the purposes for which it may be required.

Calvert himself does not state whether he used refined oils or not. Thus rape oil is used by the public both refined and unrefined, the latter being called brown rape or sweet oil; and the olives are generally used unrefined, though olive oil refined as white as water is known in the market.

The particular extent to which an oil is refined will probably give great varieties of shade. Thus, a refined rape oil from Germany gave with the 1·635 sulphuric acid test quite a different colour from a sample from Belgium; still there was evidence sufficient of other kinds to convince me both oils were genuine, and precisely the same remarks apply to two samples of cotton oil—one refined in the United States and the other refined in England.

Calvert, indeed, states himself that the colour-test is not applicable for detecting some oils. In dealing with a supposed mixture of lard oil and rape oil, he says, the colour reactions not being decisive, one conclusive test will distinguish them,—viz., that after treatment with aqua regia, and subsequent boiling with caustic soda, lard oil will give a fluid mass, and rape oil a fibrous mass. This experiment was repeated, not only with lard oil, but with tallow olein, and it was found that the caustic soda gave even a more fibrous mass with tallow olein than with rape oil—although his remarks about lard oil are correct; but this experience shows that his tables, to say the least, are very defective, and, in this particular case, worse than useless—being misleading,—seeing that tallow olein is as valuable as lard oil. However, some of Calvert's more marked reactions are sometimes useful and valuable as adjuncts in testing operations.

M. Heidenrich, M. Penot, and M. Marchand have also proposed colour-tests from the reaction of concentrated sulphuric acid upon oils, employing only a few drops of the oil placed upon a porcelain plate, but these methods are open to the same doubts and uncertainty as those of Calvert, particularly to the extent or nature of the colouration depending upon the accidental impurities of the oil.

A method of distinguishing fatty oils by the differences in the amount of heat produced by mixing 1 part of sulphuric acid with 3 parts of the oil to be tested was suggested by Maumené and elaborated by Fehling. The idea is pretty, easy of execution, and interesting in results. There is great variation in the amounts of heat produced. We find, for instance, a gain of temperature of 100° where rape oil is used, as compared with 68° when olive oil is used. This method has been investigated by the authors in so far as linseed, rape, olive, and poppy oils are concerned, and I have myself applied it as a secondary test in distinguishing several other oils.

The relative viscosities of the fatty oils is a very important and interesting subject. Schubler and Ure published some experiments on the subject many years ago. More recently I have extended their experiments, the apparatus employed being constructed as annexed:—

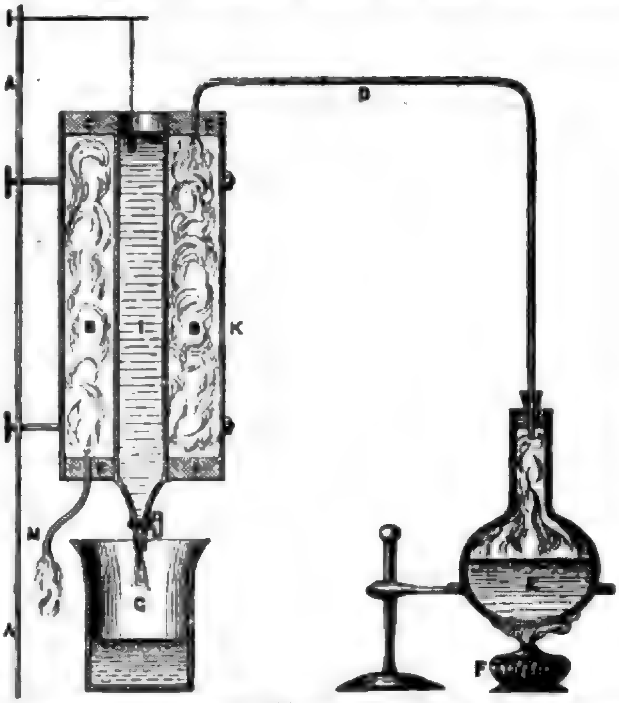
The results obtained at 120° F. were—

	M.	Sec.
French refined colza rape..	11	0
German refined rape	8	30
Neats'-foot oil	8	30
Olive	8	15
E. I. ground-nut	8	0
Tallow oil	7	30
Southern whale	7	40
Lard oil..	7	0
Cotton-seed oil	7	0
Seal oil	6	30
Lisbon seed oil	6	35
Sperm oil	5	0

A second series of experiments with a smaller apparatus confirmed the difference observed between rape oil imported from Germany and that imported from France, Belgium, and Holland—

	M.	Sec.
Belgian colza	8	15
German rape	7	30
Olive	7	30

The relative liability of fatty oils to ignite spontaneously when in contact with cotton or other waste, has been suggested by my friend, Mr. Gellatly as being characteristic.



Sketch to illustrate term Viscosity as used by Mr. Coleman.

I is the cylinder containing the oil. B the chamber filled with steam, and surrounded by the outer cylinder, K (both of glass); the steam chamber is closed top and bottom by india-rubber plugs, C, C, C, C. The steam being generated in the flask, E, passes by the india-rubber pipe into the chamber, B, until the oil reaches 120°; the stopcock is then opened, and the time taken for the oil to run out registered. The apparatus is made of such size as to allow German refined rape oil to run through in 8m. 30 secs.

The experiment is made by imbuing a handful of cotton waste with the oil to be tested, and placing it tolerably loosely in a paper-box enclosed in a hot-air bath kept at a temperature of from 130° to 200° F. After a certain length of time, characteristic of each oil, the mass enters into active combustion. Mr. Gellatly's figures are as follows:—

	H.	M.
Boiled linseed	1	15
Seal oil	1	40
Raw linseed	4	0
Lard oil..	4	0
Gallipoli olive	5	0
Refined rape.. .. .. .. (about)	9	0

Equal parts of mineral oil and seal oil refused to ignite;

Mr. Gellatly's experiments were repeated with the special view of studying the action of mineral oil in preventing or retarding combustion, and the results I attained (which were also directed to the effect of substituting wool or jute waste for the cotton) were as follows:—

	H.	M.
Seal oil on wool	3	0
Whale oil on wool	3	15
Whale oil on cotton	3	0
Whale oil on jute	9	0
Olive oil on cotton	4	0
Oleic acid on wool	13	30
80% olive oil and 20% mineral oil ..	8	0

The following mixtures refused to ignite after 26 hours' exposure to 190° to 200° F.:—

Equal parts of olive oil and mineral oil on cotton.
Equal parts of whale oil and mineral oil on jute.
Equal parts of seal oil and mineral oil on wool.
Equal parts of oleic acid and mineral oil on wool.
80% of oleic acid and 20% of mineral oil on wool.

Thus it was rendered evident that the addition of mineral oil to animal and vegetable oils has so powerful an effect in retarding the oxidation of the oil which causes the combustion that the presence of even 20 per cent materially delays, whilst the 50 per cent entirely prevents, ignition under the circumstances of the experiment. Mr. Gellatly's experiments were made between 130° and 170° F., and mine between 180° and 200° F.

(To be continued).

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,
Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 130.)

I. *Coffee and Chicory* (*continued*).*

The ash of coffee showing a remarkable constancy of composition, it occurred to me that the percentage of ash soluble in water would be a valuable criterion of the purity of any sample of coffee, and afford a simple and ready means of approximately estimating the percentage of chicory present. Of course more experiments are required before the method can be depended on, but it appears the most promising of any, as its accuracy would be unaffected by variations in the process of roasting.

I ignited three samples of genuine coffee of different kinds, and three of chicory, taking 5 grms. for each experiment. After weighing, the ash was boiled in water, the liquid filtered, the clear solution evaporated to dryness, and the residue heated to dull redness and weighed. The following were the proportions in 100 of the sample:—

	Total Ash.	Soluble Ash.		
1. Coffee	3·86	2·95 = 76	per cent of	total ash.
2. „	3·95	3·40 = 86	„	„
3. „	4·20	3·38 = 80	„	„
Average of coffees	4·00	3·24 = 81	„	„
1. Chicory (foreign)	5·36	1·20 = 22	„	„
2. „ „	5·05	1·83 = 36	„	„
3. „ (English)	4·90	2·18 = 44	„	„
Average of chicories	5·06	1·74 = 34	„	„

The proportion the soluble ash of the chicories bears to the total varies considerably, owing to the different quantities of silica present in the samples, and the percentage of soluble ash is not so constant as in the case of coffee.

Assuming 3·24 per cent as the average soluble ash of coffee, and 1·74 as that of chicory, the percentage of coffee in a mixture would be represented by the following equation, where C is the percentage of coffee, and S the percentage of soluble ash:—

$$C = \frac{(100\,S - 174)2}{3}.$$

The following are the determinations of Messrs. Graham, Stenhouse, and Campbell, of the colouring powers of coffee and its different adulterants, when roasted and infused in equal quantities of water. No attempt appears to have been made to exhaust the samples.

Caramel	1000
Mangold-wurzel	602
Bouka (a coffee substitute).. ..	602
Black malt	549
White turnips	500
Carrots	500
Chicory (darkest Yorkshire) ..	450
Parsnips..	400
Maize	350
Rye	350
Dandelion root	300
Red beet..	300
Bread raspings	275
Acorns	200
Over-roasted coffee	183
Highly-roasted coffee	173
Medium-roasted coffee	144
Another specimen coffee	150
White lupin seed..	100
Peas	73
Beans	75
Spent tan	30
Brown Malt	25

Though the method of Messrs. Graham, Stenhouse, and Campbell is objectionable, for reasons previously stated, I have found the colour of the infusion gives a very fair approximate estimate of the proportion of chicory present when the following modified process is adopted:—Instead of caramel I employ, as a standard of comparison, a mixture of various kinds of coffee with an equal weight of mixed chicory.

Mixed chicory gives almost exactly three times as strong a colour as the average coffee, and separate samples of chicory do not vary more than from 2·8 to 3·2 in colouring power, when compared with the same sample of coffee.

One gramme of the standard mixture of equal parts of coffee and chicory, and the same weight of the sample to be tested, are boiled for a few minutes with 20 c.c. of water. The liquids are cooled, and passed through a double filter, the insoluble portion being repeatedly boiled with fresh quantities of water until exhausted. The solution of the standard mixture is then made up with water to 200 c.c., and the solution of the sample to 100 c.c. 10 c.c. of the latter liquid are poured into a narrow Binks's burette, and some of the standard solution into a test-tube of exactly equal bore. If the sample consists of pure coffee the two liquids will now be of exactly similar tint, but if chicory be present the liquid in the burette will be the darker, in which case water is added till the tints are precisely equal. (The tints are best observed by placing a piece of wet filter-paper behind the tubes while they are held up to the light.) When this point is attained, the volume of the liquid in the burette is observed. Each c.c. of water added corresponds to 5 per cent of chicory in the sample. Thus, if the liquid in the burette measures 17 c.c., the sample contains 35 per cent of chicory.

From the density of a solution of a sample of mixed chicory and coffee, prepared as described on page 130, the proportions can be readily calculated by the following formula, in which C represents the percentage of coffee in the mixture, and D is the density of the solution:—

$$C = \frac{(1020{\cdot}6 - D)100}{12}.$$

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* Through a misunderstanding, this matter was not incorporated in the article on p. 129.—A. H. A.

My own estimations of the density of pure coffee infusions have given a mean of 1008·7, closely agreeing with the determinations of Messrs. Graham, Stenhouse, and Campbell, but I found the infusions of chicory often had as high a density as 1025.

It will be seen that the proportions of coffee and chicory, in mixtures of the two, can be approximately ascertained by the amount of soluble ash, by the colour of the infusion, and by the density of a solution of 1 part in 10 of water. With substances of definite composition one method would be sufficient, but with articles of so variable a nature as coffee and chicory an analyst would be very unwise to rely on the indications afforded by any method taken singly. When the different determinations are approximately concordant, the proportion of chicory may be considered proved. Of course it is not necessary to examine every sample fully, but when the microscope and the cold-water test have proved the presence of chicory it is very desirable to ascertain the proportion in which it exists. When the coffee contains other adulterants as well, the problem becomes too complicated for solution in the present state of the subject.

Infusions of coffee and chicory are quickly and completely decolourised by potassium permanganate. I have taken advantage of this fact for ascertaining the presence of starch in coffee and chicory. The following method is preferable to that in which animal charcoal is employed:—The sample is boiled for a few minutes with water, and, *when cool*, the liquid is acidified with sulphuric acid, and permanganate added till the colour of the solution is destroyed. The clear liquid is then decanted or strained away from the insoluble matter, and tested for starch with solution of iodine. The well-known blue colouration is produced if the sample was adulterated with any cereal or leguminous seed, and the intensity of the tint affords a rough idea of the extent to which the adulteration was practised. As this test only occupies a few minutes, and a negative result by it proves the absence of a large class of adulterants, it will often save the trouble of a tedious examination under the microscope.

The insoluble matter remaining after treatment with permanganate, &c., can be advantageously examined under the microscope, the peculiar structure of chicory, &c., being more readily observed on account of the removal of the colouring matter.

The most common adulterants of chicory and coffee are caramel, locust beans, acorns, rye, maize, mangold-wurzel, and carrots, but the use of most of these admixtures has been almost abandoned since the New Adulteration Act came into operation.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 17, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. A. Bottle, J. Linford, and Henry Deacon were formally admitted Fellows of the Society.

The names read for the first time were those of Messrs. Frederick W. Fletcher, Alfred A. Wolff, and William Pearce, jun.

For the third time—Messrs. Edward Townley Hardman, Leslie Crassweller Hill, Thomas William Shore, William Kellner, and Andrew Fuller Hargreaves, who were ballotted for and duly elected.

The President then called on Professor James Dewar to deliver his lecture "*On Dissociation.*"

The Lecturer premised that he had no new facts to bring before his audience, but must content himself with condensing and epitomising the labours of others. There were two very remarkable ideas which had sprung up early in the history of our science connected with this subject of dissociation. Of these, one was that of Priestley on the ameliorating action of vegetables on our atmosphere; the other that of Hutton, the geologist, who, in discussing the constitution of rock masses, came to the conclusion that they were formed under great pressure, and that this pressure modified the action of heat on the rock mass. He did not, however, experimentally prove it to be the case; this was reserved for his pupil, Sir James Hall, afterwards President of the Royal Society, who, in his classical investigation, proved that carbonate of lime could be fused under pressure without evolution of carbonic anhydride, and that the mass obtained on cooling was identical with marble. He moreover determined the pressure by mechanical means, and found it to be about 51 atmospheres. His numerous experiments were made partly in strong gun-barrels, and partly in tubes drilled out of wrought-iron; the carbonate of lime, usually enclosed in platinum, was first inserted, the remainder of the tube, after the introduction of a little borax, being filled with a fusible metal which solidified and firmly closed the apparatus. The end containing the carbonate was then heated in a furnace whilst the other was kept cool.

Nothing more was done in this direction until Grove proved that water was decomposed at a temperature below that produced by the union of oxygen and hydrogen: this is the germ of the principle of dissociation.

Dr. Robson, of Armagh, some time afterwards, inferred by the variation in the electromotive force that the relations between the elements in water were changed at a comparatively low temperature, and calculated that at about 2000° C. water would be split up into oxygen and hydrogen.

The next great step was made by Deville, who, when working with the oxyhydrogen furnace, measured the temperature produced, and found that it was much less than that theoretically obtainable. His well-known experiments on the instability of compounds at high temperatures, proved that the decomposition of carbonic anhydride, carbonic oxide, water, hydrochloric acid, &c., took place at a certain temperature, and, as the temperature was lowered, combination again occurred. By passing the vapour of water through a narrow porous tube, and carbonic anhydride through the annular space between it and a larger outer tube of glazed earthenware strongly heated, the aqueous vapour was partly decomposed, and the hydrogen diffused into the atmosphere of carbonic anhydride in the outer tube. Similarly, carbonic anhydride passed over fragments of intensely-heated porcelain is partly resolved into carbonic oxide and oxygen. The decomposition of carbonic oxide was shown by passing a stream of cold water through a narrow metal tube, and carbonic oxide through the annular space between it and the larger exterior porcelain tube intensely heated in a furnace. Carbon was deposited on the lower part of the metallic tube. By means of a similar apparatus, the decomposition of hydrochloric acid and sulphurous anhydride was also proved. These decompositions, which take place at a temperature of from 1200° to 1400° C., merely afford, however, a proof that heat acts antagonistically to chemical attraction, but do not give any relation between the temperature and the amount of decomposition. This was attained by Debray by a modified form of the experiment of Hall on carbonate of lime. Instead of registering the pressure at the fusion-point of the carbonate, he heated calc-spar in a vacuum, in an iron tube, to a constant temperature. At the boiling-point of mercury or sulphur, 300° to 400° C., there was no perceptible decomposition, but, on increasing the temperature to 800° C., the boiling-point of cadmium, decomposition sets in and increases until the evolved carbonic anhydride has a tension of 85 m.m. On increasing the heat to 1040° (in the vapour of zinc), m anhydride is evolved until the pressure is 520 m.m. On again allowing it to cool to 800°, the tension diminishes to 85 m.m., and then remains constant. When cold, of course, all the carbonic anhydride is again re-absorbed. This shows a definite relation between the amount of decomposition and the temperature, or that the tension of dissociation is a function of the temperature. It is, moreover, the same whether there is much or little calcium carbonate in the experimental tube, and is, therefore, quite independent of the mass.

From that time a continually increasing number of observations have been made. Those on the compounds of ammonia with silver chloride and calcium chloride are more manageable, as these substances decompose more readily and at a lower temperature. A complete series of experiments has been made on the silver compound, and the curve representing the tension at different temperatures is sensibly parallel to that of the tension of aqueous vapour, showing that the law of dissociation for this compound is similar to that of the vapour tension of water.

By the dynamical theory of heat, there is a definite relation between the pressure, the latent heat, and the temperature, and the mechanical equivalent of any small alteration of volume can therefore be represented by an equation. The mechanical equivalent, or the heat required to boil or volatilise a liquid, may be derived from the equation—

$$L = T(V - v)\frac{dp}{dt}$$

L being the latent heat, T the temperature, V and v the different volumes, and dp and dt the alteration in pressure and temperature. Similarly, the latent heat of the vapour can be calculated from the tension. Rankine has shown that the equation—

$$\log. P = A - \frac{B}{t} - \frac{C}{t^2}$$

represents all curves of liquids, where P is the pressure, t the temperature, and A, B, and C are constants. As the latent heat of vapours can be calculated from the tension, it follows that in dissociation when the chemical compound is decomposed, the heat absorbed, L, which is equivalent to the heat evolved in their formation, can be calculated from the tension. Curves of tension are very difficult to obtain accurate, the simplest form of this equation being—

$$\log. \left(\frac{P_1}{P_2}\right) = \frac{J.L.d_0}{P_0} \cdot \frac{a(T_2 - T_1)}{(1 + at_2)(1 + at_1)}$$

where P_1 and P_2 are two pressures, J the Joule equivalent, L the latent heat, d_0 the density at 0° C., P_0 the pressure at 0° C., a the coefficient of expansion of the gas or vapour, and T_1, &c., the temperatures.

Debray's observations on the evolution of aqueous vapour by certain hydrated salts, such as the two hydrates of sodium phosphate—namely, the one with $12H_2O$, and the one with $7H_2O$—show that the compound decomposes in a manner similar to calcium carbonate, giving off water vapour of a constant tension for a constant temperature. From an observation of the curves representing the tension, it appears that the one with $12H_2O$ behaves like a compound of water with the salt containing $7H_2O$, the latter, however, still giving off aqueous vapour, but at a lower tension for a given temperature. The curves of both these hydrates are comparable with the curve of aqueous vapour. The vapour tension of salts containing water of crystallisation thus affords a means of determining the several hydrates which any salt is capable of forming.

Regnault has made careful determinations of the tension of liquefied carbonic anhydride, sulphuretted hydrogen, ammonia, and sulphurous anhydride for various temperatures, and also of the latent heat of carbonic anhydride and ammonia by the evaporation of the liquids. The latent heat, calculated from the vapour tension between −25° C. and +45° C., corresponds very closely with that observed directly. The lecturer had made an attempt to directly determine the latent heat of mercury vapour by passing it into water contained in a calorimeter, but the difficulties attendant on the investigation prevented his obtaining very concordant results. The numbers obtained gave the latent heat at between 70 and 80 units. In the decomposition of cyanuric acid into cyanic acid, it was found that, up to 400° C., as the temperature rises, the tension of the vapour increases in a certain definite ratio, cyamelide giving a curve of similar type. The lecturer also described the curves representing the tension for the transformation of paracyanogen into cyanogen, that of ordinary phosphorus, and of the limiting pressures of the red allotropic form of phosphorus. In the latter case, the difference of the latent heats is equivalent to the evolution of heat in the transformation of the one allotropic form into the other.

One of the most recent and interesting investigations was that of the dissociation of hydrogenium. It has been found that Graham's compound of palladium and hydrogen, containing two equivalents of the former to one of the latter, is stable. When heated it gives a definite tension for a definite temperature, and this is independent of the mass. If, however, it is charged with more hydrogen than this the tension varies. In the latter case the compound may be regarded as a solution of hydrogen in the compound Pd_2H. This affords an interesting instance of the use of dissociation to ascertain whether a substance is a definite chemical compound or not.

It must be observed that there is continuity in the effects of dissociation, whereas chemical compounds proceeded by abrupt jumps. For instance, there is no continuity between the various oxides of any metal, each is well-defined, with a break between it and the next oxide.

The speaker concluded his able and interesting discourse with a description of an apparatus he had devised for ascertaining the temperature produced when a mixture of oxygen and hydrogen was exploded under various pressures.

The lecture was illustrated by numerous diagrams of curves corresponding to the tension of dissociation of the various compounds.

The President said it was needless to ask the Fellows to give formal expression to their thanks to Mr. Dewar for his admirable lecture. It would be of great interest to investigate the tension of dissociation of those bodies which, like oil of vitriol, gave anomalous vapour-densities.

Professor Foster thought it was one of the great advantages of a lecture like the present, in contradistinction to the usual papers, that it treated of matters lying outside the ordinary field of chemistry. There was very much to be done on the border-land between chemistry and purely physical science.

Mr. Norman Lockyer said some of the remarks of the lecturer had seemed familiar to him from their resemblance to certain observations he had made in his spectroscopic work, and suggested that chemists should study the spectra of the metalloids and metals, especially the soda metals, paying particular regard to the relation between the temperature and the appearance of given lines.

Mr. Dewar, in answer to a question by Dr. Wright, said that there were certainly cases which were exceptions to the rule that the dissociation was greater the less the pressure, but the number known was very small compared with those that followed the general law.

The meeting was then adjourned until Monday, March 30, the anniversary meeting. The next general meeting will be on Thursday, April 2, when the following papers will be read:—(1) "On Sulphocyanide of Ammonium and Sulphocyanogen," by Dr. T. L. Phipson. (2) "Note on a Reaction of Gallic Acid," by H. R. Procter. (3) "On the Cobalt Bromides and Iodides," by W. Noel Hartley. (4) "On the Distillation of Sodium Ricinoleate," by E. Neison. (5) "Note on the Solubility of Plumbic Chloride in Glycerine," by H. Piesse. (6) "On Ozone as a Concomitant of the Oxidation of the Essential Oils, Part I.," by C. T. Kingzett. (7) "Action of Benzyl Chloride on Camphor, Part II.;" (8) "Researches on the

Preparation of Organo-metallic Bodies of the C_nH_{2n} series of Hydrocarbons;" and (9) "Action of Benzyl Chloride on Alcohol," by Dr. D. Tommasi.

PHYSICAL SOCIETY OF LONDON.

The first ordinary meeting of the Physical Society of London was held in the Science Schools, South Kensington, on the 21st inst., Dr. Gladstone, F.R.S., in the chair.

The Chairman gave a brief description of the objects and organisation of the Society, and announced that ninety-nine gentlemen had already expressed their desire to join the Society as original members.

Mr. J. A. Fleming, B.Sc., read a paper on the "*Contact Theory of the Battery.*" After discussing the most recent views regarding the contact and chemical theories, Mr. Fleming exhibited the action of his new battery, in which metallic contact of dissimilar metals is completely avoided. The battery consisted of thirty test-tubes of dilute nitric acid alternating with the same number of tubes of pentasulphide of sodium, all well insulated. Bent strips of alternate lead and copper connected the neighbouring tubes. By this device, the terminal poles are of the same metal. On connecting with a coarse galvanometer, the needle was violently and permanently deflected. Tested by the quadrant electrometer, the potential was shown to increase regularly with the number of cells. The sixty cells on first immersion showed a potential exceeding that of fourteen Daniell's cells. The principle upon which the action depends is that, in the acid, lead is positive to copper; in the sulphide it is negative. Mr. Fleming further showed how, by using the single liquid, nitric acid, and the single metal, iron, a similar battery could be constructed, provided one-half of each iron strip were rendered passive. In this form, also, no metallic contact occurred.

Prof. F. Guthrie exhibited experiments illustrating the distribution of a galvanic current on entering and leaving a conducting medium. This was shown in the case of solids by the stratification of iron-filings on sheets of copper and lead. The effect of the distribution on a magnetic needle which is hung near a conducting vertical sheet in the magnetic meridian—into the upper horizontal edge of which a current enters, and out of which it passes at the same elevation—is to alter the direction of the needle's direction of turning, according as the needle is lowered or raised. At a distance from the upper edge of one-third the distance of the interval between the poles, the needle is at rest. A similar effect was shown in a liquid conductor.

Prof. Foster, Dr. Wright, and Dr. Gladstone took part in the discussion of the communications.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Ordinary Meeting, February 26th, 1874.

Dr. Lunge, President, in the Chair.

The following paper was read by Mr. J. Pattinson:—"*On the Rate at which Bleaching-Powder Loses its Available Chlorine.*" In dealing commercially with an article of such vast importance as bleaching-powder, unstable in its composition, and the value of which is determined by the amount of chlorine it contains in a condition available for bleaching purposes, the question naturally very often arises—"How much available chlorine does it lose in a given time?" The examination of a number of samples of bleaching-powder, from time to time, during about twelve months, the results of which are given below, was undertaken with the view of making a contribution towards the solution of this question, and also to the further one—"Does weak bleaching-powder, say containing about 32 per cent of chlorine, retain its strength better than a stronger bleaching-powder?"

The samples examined were made by what is now known as the old process, in which the chlorine is generated in the ordinary stone stills by the action of hydrochloric acid on native peroxide of manganese. Three sets of samples were obtained from different manufactories on the Tyne, each set consisting of three samples. It was intended that the three samples of each set should be taken from the same portion of lime—one when it contained about 33 per cent of available chlorine, one when it contained about 35 per cent, and the third when it contained about 37 per cent—and with this object the lime was placed in a box in the chlorine chamber, so that it could be easily removed in order to take out the samples at each stage. The samples marked "No. 1" were first taken, then the boxes containing the remainder of the lime were replaced in the chambers to absorb more chlorine. The samples marked "No. 2" were then taken, and the boxes again replaced in the chambers to receive more chlorine, when the "No. 3" samples were taken. The samples obtained, although not exactly of the strengths wished, are perhaps sufficiently near for the required purpose. They were placed in glass bottles holding about half a pound, and kept in these, loosely corked, in a room where they were never exposed to the direct rays of the sun. At first they were tested about once a week, afterwards once a fortnight, and ultimately once a month during the last six months.

The process used for testing was that known as Penot's process, in which an alkaline solution of arsenious acid, with iodised starch-paper as indicator, is employed.

The following tables give the percentages of available chlorine in the various samples on the dates named:—

	A 1.	A 2.	A 3.
January 20, 1873 ..	28·7 %	37·4 %	37·1 %
,, 28, ,, ..	28·5	37·3	36·8
February 4, ,, ..	28·4	37·1	36·6
,, 12, ,, ..	28·3	37·1	36·4
March 22, ,, ..	28·2	36·7	36·0
,, 31, ,, ..	27·7	36·6	35·8
April 14, ,, ..	27·7	36·6	35·8
,, 24, ,, ..	27·7	36·5	35·8
May 6, ,, ..	27·6	36·4	35·7
,, 24, ,, ..	27·3	36·0	35·2
June 18, ,, ..	26·5	35·4	34·6
July 4, ,, ..	26·0	35·1	34·3
August 8, ,, ..	24·5	33·8	33·2
September 8, ,, ..	23·5	33·3	32·3
October 27, ,, ..	22·6	32·3	30·9
November 19, ,, ..	—	32·2	30·9
February 3, 1874 ..	20·8	31·2	30·2
	B 1	B 2.	B 3.
December 11, 1872 ..	32·9 %	35·2 %	36·7 %
,, 21, ,, ..	32·6	34·8	36·4
January 2, 1873 ..	32·4	34·6	36·1
,, 18, ,, ..	32·2	34·4	35·9
,, 28, ,, ..	32·0	34·2	35·7
February 4, ,, ..	31·8	34·2	35·4
,, 12, ,, ..	31·6	34·2	35·4
March 22, ,, ..	31·6	34·2	35·3
,, 31, ,, ..	31·3	34·2	34·8
April 15, ,, ..	31·3	34·0	34·7
,, 24, ,, ..	31·2	34·0	34·6
May 6, ,, ..	31·0	33·9	34·5
,, 26, ,, ..	30·4	33·4	34·2
June 18, ,, ..	30·0	32·9	33·3
July 4, ,, ..	29·6	32·3	33·0
August 8, ,, ..	27·9	31·3	31·6
September 8, ,, ..	26·8	30·3	30·8
October 27, ,, ..		29·0	29·8
November 19, ,, ..	—	28·3	29·0
February 3, 1874 ..	22·2	27·9	28·0
	C 1.	C 2.	C 3.
January 20, 1873 ..	31·8	37·6 %	37·6 %
,, 28, ,, ..	31·6	37·5	37·6
February 4, ,, ..	31·4	37·4	37·4
,, 12, ,, ..	31·4	37·2	37·4

	C 1.	C 2.	C 3.
March 8, 1873 ..	31·4	37·2	37·4
" 22, " ..	31·4	37·0	37·3
" 31, " ..	31·0	36·7	37·0
April 15, " ..	30·8	36·5	37·0
" 24, " ..	30·8	36·4	36·9
May 6, " ..	30·7	36·2	36·9
" 24, " ..	30·5	35·9	36·5
June 18, " ..	30·2	35·0	36·0
July 4, " ..	29·7	34·3	35·8
August 8, " ..	28·6	32·5	34·3
September 8, " ..	27·8	31·5	34·3
October 27, " ..	27·3	30·2	33·2
November 19, " ..	26·9	29·8	32·9
February 3, 1874 ..	26·4	28·2	32·3

There were but very small quantities remaining of the samples marked "A 1" and "B 1" on February 3, 1874, and this may account for the exceptionally large loss of chlorine between this date and the date of the previous testings. I have therefore excluded these results in calculating the averages given in the following tables.

On examining the above tables it will be seen that, as might have been anticipated, the loss of chlorine is greater in the warm summer months than in the winter months. The following table shows the total loss of chlorine during the three months ending April 24, the three months ending September 8, and the three months ending February 3, 1874:—

	3 Months ending April 24.	3 Months ending Sept. 8.	3 Months ending Feb. 3, 1874.
A 1 ..	1·0 %	3·0 %	— %
A 2 ..	0·9	2·1	1·0
A 3 ..	1·3	2·3	0·7
B 1 ..	1·0	3·2	—
B 2 ..	0·4	2·6	0·4
B 3 ..	1·3	2·5	1·0
C 1 ..	1·0	2·4	0·5
C 2 ..	1·2	3·5	1·6
C 3 ..	0·7	1·7	0·6

The *average* loss of chlorine, taking the whole of the samples into account, was, during the three months ending April 24, 0·33 per cent per sample per month; during the three months ending September 8, 0·86 per cent per month; and during the three months ending February 3, 1874, 0·28 per cent per month. The greatest loss in any one month was in the month ending August 8, when the samples lost as follows:—

A 1	1·5 %
A 2	1·3
A 3	1·1
B 1	1·7
B 2	1·0
B 3	1·4
C 1	1·1
C 2	1·8
C 3	1·5

The average loss for this month being 1·4 per cent of chlorine, taking the whole of the samples into account.

The following table shows the average loss of chlorine per month in each sample during the whole time each sample was tested:—

A 1	0·68 %
A 2	0·52
A 3	0·58
B 1	0·68
B 2	0·60
B 3	0·72
C 1	0·50
C 2	0·90
C 3	0·50

The average loss per month is 0·63 per cent.

The total loss of available chlorine in each sample from January 20 to September 8, a period of about eight and a half months, during which all the samples were tested, was as follows:—

A 1	5·2 %
A 2	5·1
A 3	4·8
B 1	5·4
B 2	4·1
B 3	5·1
C 1	4·0
C 2	6·1
C 3	3·3

On examining the above tables it will be seen that, with reference to the question as to the relative stability of weak and strong bleaching-powder, there is practically no difference in the rate at which they lose available chlorine. The weak 28·7 per cent bleaching-powder loses its strength at about the same rate as the 37 per cent samples.

These results are not presented as definite answers to the questions with which I set out, but only as a small contribution to what is necessarily a very wide and somewhat complicated inquiry. Whether the loss of strength goes on in the same ratio in large masses in casks as it has done in the comparatively small quantities I had in bottles; the effect of using lime containing various amounts of water of hydration; the influence of different temperatures in the chamber during the time chlorine is being absorbed; and various other conditions affecting the stability of bleaching-powder, all require investigation. Whether the bleaching-powder made by the Deacon process keeps better than that made by the old process, as is sometimes asserted, is a question I should also like to see examined. I trust that some of our members, who have more time and better opportunities than I have, will take up the investigation of some of these points, and give to the Society the result of their inquiries.

The President said it would be interesting to enquire more fully as to (1) whether, under all circumstances, weak and strong bleach lost strength at the same rate; (2) whether, as was believed by many, shaking in transit accelerated the loss. He hoped the subject would be further pursued.

Mr. Lomas thought the loss depended partly upon the rapidity with which the bleach was made, and partly on the way in which it was packed, which might make a difference of 1 per cent.

Mr. Glover suggested that some of the younger members might advantageously devote themselves to the study of the exact states of combination in which chlorine exists in bleach.

Mr. Pattinson said this question had formed part of the inquiry which he had proposed to undertake, but the results, in this direction, were hardly ready for publication.

The President promised to bring forward some extracts from Continental authorities on the discussion of the paper.

CORRESPONDENCE.

VALUATION OF SALT-CAKE OR CRUDE SULPHATE OF SODA.

To the Editor of the Chemical News.

Sir,—I have frequently had occasion to observe the considerable differences in the results of analyses of identical samples of salt-cake by different analysts of repute. That these differences are not due merely to unavoidable "errors of analysis" is evident from the fact that certain chemists invariably give results from 1 to 3 per cent higher than certain others. The true explanation appears to lie in the various methods employed, and I have thought a consideration of those processes likely to be useful. The following represents the composition of an average sample:—

Sulphate of soda	95·25
Sulphate of lime	1·25
Chloride of soda	1·75
Sulphuric acid (free)	1·00
Silica and ferric oxide	0·50
Moisture	0·25
	100·00

The method which seems the one best calculated to give the true composition of such a sample is as follows:—The free H_2SO_4 and undecomposed NaCl are determined by standard solutions of carbonate of soda and nitrate of silver respectively; sulphate of lime, by oxalate of ammonia; silica and peroxide of iron, by precipitation by ammonia or acetate of soda; and moisture, by drying at 100° C.

Another method, which is favoured by the "high" analyst, differs from the above, inasmuch that the "free acid and moisture" are estimated together by the loss of weight on ignition or roasting of a sample. Now it is clear that the result of ignition must be that a portion of the free H_2SO_4 will react on part of the NaCl, forming Na_2SO_4 and liberating HCl. Thus the analyst performs a manufacturing operation in the process of his analysis, and his "results" represent a higher percentage of Na_2SO_4 than is really present in the original sample. And the amount of this error varies with the composition of the sample.

In order to obtain a greater uniformity in the results of analysis of this substance, it seems desirable that chemists should agree as to the most proper analytical processes to be employed; and I have offered these remarks in the hope to elicit the views of others on the subject.—I am, &c.,

WALTER TATE.

Dublin, March 23rd, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 2, 1874.

Irrigation Canal from the Rhone.—M. Dumont.—The Conseil General des Ponts et Chaussées have pronounced favourably on the project, and it is now being submitted to an enquiry of public utility in the five departments concerned. The canal will allow of irrigating or submerging a surface of 80,000 hectares; two-thirds of which consist of rich vineyards, nearly all ravaged by the Phylloxera.

Note on Magnetism.—M. Jamin.—Reply to M. Gaugain.

Direct Demonstration of the Equation $\int \frac{dQ}{T} = 0$ for every Cycle, Closed and Reversible. (Concluded.)—M. Ledieu.

History of the Question of the Gliding of a Bird in the Air.—M. Penaud.—The author finds the views expressed by M. Marey to be of much older date.

Trepidations of the Ground at Nice.—Letter from M. Prost.

Apparent Orbit and Period of Revolution of the Double Star ζ of Hercules.—M. Flammarion.

Variable State of Voltaic Currents.—M. Blaserna.—Reply to M. Cazin.

New Saccharimeter, and a Means of Rendering the Flame of Sodium quite Mono-Chromatic.—M. Laurent.—The novelty consists in a thin cleft plate of gypsum covering the half of a diaphragm between the polariser and the analyser. Placed between two Nicols, the principal sections of which are perpendicular, this plate gives yellow corresponding to the sodium line D, whether with white or with yellow light. If the Nicols have their sections parallel, with white light, the complementary colour, blue-violet, is obtained; with yellow light, black. The plate produces very simply the effect of a polariser in two parts, of which the principal sections make a certain angle with each other, and this can be readily varied from zero to 45°, which is convenient in some applications; thus a given liquid being more or less discoloured one may choose the angle which will give maximum precision. To render the sodium flame monochromatic M. Laurent interposes between flame and polariser a plate of cleft bichromate of potash, which absorbs the violet and blue rays, and part of the green, in the sodium flame; rays which diminish the precision where the equality of shades is to be pronounced upon.

New Laboratory Balance.—M. Deleuil.

Researches on the Outflow of Liquids from Capillary Tubes.—M. Gueront.—The author verified Poiseuille's law, and studied the internal constitution of the liquid column in the tube during outflow. He applied at the lower mouths of the tubes, successively, several thin ivory diaphragms, with an aperture smaller than that of the tube. It was thus shown that, with the same aperture of diaphragm, the outflow is more rapid the larger the tube to which the diaphragm is fitted. Next, applying to the same tube diaphragms with different apertures, the velocities were found greatest with orifices the most distant from the walls of the tube. The results are explained by supposing that the liquid moves in the tube by concentric cylindrical layers, having velocities which are greater as the diameters are less. Some exceptions to this M. Gueront proposes to discuss in another note.

Supposed Liberation of Ozone by Plants.—M. Bellucci.—The author passed air containing 1-100th of its volume of carbonic anhydride for six hours, in the daytime, through a glass tube, part of which was covered with black paper, to a receiver enclosing living plants, whence it issued by a second like tube. In each of the tubes were placed two ozonoscopic papers. Now it appears that the papers in the dark parts of both tubes were quite unaltered; and the change in the others could only be produced by ozone existing in the air which traversed the apparatus. The intensity of colouration of the paper exposed to light in the second tube almost exactly corresponded to that of the paper in the illuminated part of the first tube; thus excluding the supposition that the chemical activity of the air was due to ozone produced by the plants. The author thinks M. Cloëz's view confirmed, according to which the combined action of humid oxygen and solar light accounts for the colouration of iodised starch-paper, independent of ozone.

Conditions under which Lead is Attacked by Water.—M. A. Bobierre.

Remarks Relative to the Foregoing Communication.—M. Belgrand.

Action of Water, Ordinary and Distilled, also of Distilled Sea-water upon Lead, and upon the Tin Condensers of the Apparatus for Distillation.—M. L. Besnou.—These three papers all refer to the effects of leaden service-pipes used in the water supply of towns—a subject which is receiving at present much attention in Paris. The results obtained agree with those of former experimentators.

Lateral Solfataras of the Volcanos of Chili and on Certain New Minerals.—M. T. Domeyko.—The author describes two classes of solfataras; the former open in elongated rifts, and throw out enormous masses of shattered rocks, producing trachytic conglomerates; they emit jets of gas and steam for a short time, and leave scarcely any deposits of sulphur. Those of the second class are permanent, their emissions of gas and steam are slow and continuous, and they yield large quantities of sublimed sulphur. The author mentions certain novel minerals which he has presented to the museum of the Ecole des Mines, but the descriptions and analyses are not given.

Oxalurate of Ethyl, and the Cyanurate of Oxamethan.—M. E. Grimaux.—The author, attempting to convert oxamethan into oxalurate of ethyl by the action of cyanic acid, obtains a body possessing the composition of the oxalurate sought for, but which on further examination proved to be an isomer, the cyanurate of oxymethan.

Ammoniacal Fermentation of Urine.—M. A. Lailler.—The author mentions certain diseases of the nervous system in which the urine is strongly ammoniacal at the time of its emission.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, January 12, 1874.

Constitution of the Dibrom-Benzols.—C. Wurster.—The author undertook a complete investigation of the solid and of the two liquid varieties of dibrom-benzol. He considers that Reise's dibrom-benzol, in so far as it is distinct from meta-dibrom-benzol, must belong to the ortho series. He obtained tribrom-benzol from dibrom-anilin, and dibrom-anilin from nitro-dibrom-benzol.

Nitro Compounds of the Fatty Series.—Victor Meyer.—This paper, the author's seventh communication on the same subject, is not well adapted for abstraction.

"Continuing Rays" of Becquerel.—Hermann Vogel.—In 1843 Becquerel published observations according to which the red, yellow, and green rays, though chemically inactive *per se*, are capable of keeping up action which has been communicated by the chemically active rays (*Annales de Chimie et Physique*, Nov., 1843). Becquerel appears to have experimented with impure bromide and iodide of silver. His statements were contested by Draper. Claudet obtains diverse, mutually-conflicting results. Guetzlaff has recently revived Becquerel's view, and has recommended to give photographic plates, after a short exposure, a supplementary exposure under glass coloured so as to cut off the blue end of the spectrum. The author, along with Zencker and Prümm, investigated this point in the course of last summer, and found that in case of the ordinary brom-iodo silver process a supplementary exposure under red glass was perfectly inoperative. The author explains the apparently continued action of red and yellow light upon chloride of silver in another manner. Pure white chloride of silver, ($AgCl$), is sensitive to the violet and ultra-violet rays only, but by these it is reduced to the violet subchloride, (Ag_2Cl), which as Seebeck, Herschel, Poitevin, and others have shown, is sensitive to almost every ray of the spectrum. When Becquerel exposed chloride of silver paper for a short time to daylight "till a slight commencement of action was perceptible," a small quantity of the violet chloride of silver would necessarily be formed. As this compound is sensitive to red and yellow rays we cannot wonder that these exerted their action.

On Diphenyl-ethan.—Guido Goldschmiedt.—Diphenyl ethan has been obtained in a state of perfect purity by the reduction of diphenyl-trichlor-ethan.

On Hellenin and Alant Camphor.—J. Kallen.—The author finds that Gerhardt's hellenin is a mixture of two distinct bodies, true hellenin and a camphor-like body, which he names alant camphor. The former is C_6H_8O, the latter $C_{10}H_{14}$.

Chemical Constitution of Chloride of Lime.—C. Schorlemmer.—The author contests the view of Berthollet, recently revived by Goepner, that the bleaching compound contained in chloride of lime is not a hypochlorite, but a direct compound of lime and chlorine.

Miscellaneous Communications.—V. Merz and W. Weith.—The authors have been experimenting on diphenylamin and its derivatives, on the sulpho acids of diphenylamin, on triphenylamin, and on the behaviour of sodium ethylate when heated. Following up the observation of Wanklyn that bright sodium remains unattacked even if gently heated in a current of dry chlorine, they have examined the comparative reactions of sodium and potassium with bromine, iodine, aniline, &c., and find sodium little affected, whilst potassium reacts violently.

Contributions towards Establishing the Position-Formulæ of the Allyl Compounds and of Acrylic Acid.—E. Linnemann.—From this lengthy paper we extract merely the inference "that acrolein is either not the true aldehyd of acrylic acid, or that the formula deduced from that of the normal fatty bodies is wanting for one of the two; or, lastly, that neither acrolein nor acrylic acid are constituted analogously, either to the aldehyds, or to the fatty acids.

Certain Tables of Affinity.—Julius Thomsen.—Incapable of abstraction.

Remarks on J. Thomsen's Paper "On the Influence of Temperature on the Chemical Development of Heat."—L. Pfaundler.—A critique on Prof. Thomsen's paper which appeared in *Berichte*, vol. vi., p. 1335.

Action of Cyanide of Potassium upon Croton-Chloral.—O. Wallach and A. Bœhringer.—The result of the reaction is mono-chloro-crotonic ether.

Certain Derivatives of Liquid Dibrom-Benzol.—C. Wurster.—This paper consists chiefly of hypothetical formulæ.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, September and October, 1873.

Composition of Lithion Mica.—J. Rammelsberg.

New Series of Diamines which occur as Secondary Products in the Manufacture of Methylanilin.—A. W. Hofmann and Martius.

Violet Colour-Derivatives of Methylanilin.—A. W. Hofmann.

Violet Derivatives of Rosanilin.—A. W. Hofmann.

NOTES AND QUERIES.

Estimation of Nitrogen.—Will any of your readers kindly give me a method of estimating nitrogen existing in nitrate of soda in the presence of nitrogenous organic matter and sulphate of ammonia?—Student.

Boiling Litharge, &c.—Will any of your readers kindly inform me my best way to boil the following ingredients into a white mass—namely, litharge, 5½"; olive oil, 10"; water, a sufficiency to boil, say, four or five hours, or anything that will bleach the above white.—W. M. M.

Small Motive-Power.—If it were possible to devise a small machine fulfilling every requirement, to be worked by any convenient power, to agitate certain solutions in chemical analysis—as, for instance, to promote the formation of the double phosphate of magnesia and ammonia, thus saving the laborious process of hand-stirring, and consequent liability to breaking of beakers, &c.,—would such a machine be acceptable to the profession of analytical chemists generally?—H. H. H.

MEETINGS FOR THE WEEK.

Monday, March 30.—Medical, 8.
— London Institution, 4.
— Chemical, 8. Anniversary.
Tuesday, 31.—Civil Engineers, 8.
Wednesday, April 1.—Microscopical, 8.
— Pharmaceutical, 8.
Thursday, 2.—Chemical, 8.

TO CORRESPONDENTS.

Delta.—Plateau's papers in the *Philosophical Magazine.*

A. G. Phillips, G. E. Webster, and others.—We cannot see that any useful object will be gained by continuing the discussion.

J. H. S.—We do not know.

Chemist.—Consult a professional chemist. The reply would be too long for our "Answers to Correspondents" column.

THE CHEMICAL NEWS.

Vol. XXIX. No. 749.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.[*]

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 138).

CALCULATION OF VACUUM-WEIGHT OF GLASS APPARATUS + NITRATE OF THALLIUM FROM GIVEN DATA.

First Weighing in Air of Ordinary Density.

By Table A,

$$\log. \frac{0{\cdot}00129381}{1+0{\cdot}03656t} \cdot \frac{1}{780} \text{ for } 22{\cdot}7^\circ \text{ C.}$$

$$\begin{aligned} &t\ 22^\circ \text{ is } 4{\cdot}197488-10 \\ &t\ {\cdot}7 \text{ is } \phantom{4{\cdot}19}1027 \\ \hline &\phantom{t\ 22^\circ \text{ is }} 4{\cdot}198515-10 \end{aligned}$$

By Table B,

$$0{\cdot}378\tfrac{3}{8}v \text{ for } t=22{\cdot}7=5{\cdot}17 \text{ millims.}$$

$$759{\cdot}22-5{\cdot}17=753{\cdot}05;$$

$$\log.(753{\cdot}05)=(2{\cdot}8768238-10)+4{\cdot}198515=$$

$$\log. 7{\cdot}0753388-10=\log. \frac{\text{den. atmos. air}}{\text{max. den. water}}$$

Second Weighing in a Rare Atmosphere.

By Table A the value of

$$\log. \frac{0{\cdot}0012938}{1+0{\cdot}00365t} \cdot \frac{1}{768} \text{ for } t=21^\circ \text{ C.} =$$

$$=(4{\cdot}198959-10)+2{\cdot}0532321=6{\cdot}2521911-10=$$

$$\log. \frac{\text{den. rare air}}{\text{max. den. water}}$$

Value of $0{\cdot}378\tfrac{3}{8}v$ for $t=21^\circ$ C. $=4{\cdot}66$ millims.:

$$117{\cdot}70 \text{ millims. (pressure)} - 4{\cdot}66 = 113{\cdot}04 = p' - 0{\cdot}378\tfrac{3}{8}v,$$

$$\log. b' = 1{\cdot}6834703+6{\cdot}2521911-10=7{\cdot}9356614-10;$$

$$\therefore {\cdot}0086231 = z = \text{weight of rare air displaced by } y.$$

The data now are—

$$\begin{aligned} w &= 1005{\cdot}425937, \\ x &= 0{\cdot}059140, \\ y &= 1005{\cdot}726438, \\ z &= 0{\cdot}0086231, \end{aligned}$$

$$\log. \frac{l}{k} - 6{\cdot}2521911 - 7{\cdot}07653388 = 9{\cdot}1768523-10.$$

Hence $n=\frac{l}{k}={\cdot}15026$:

$$\begin{aligned} &1-n={\cdot}84974, \\ &y-w=1005{\cdot}726438-1005{\cdot}425937={\cdot}300501, \\ &x-z={\cdot}059140-{\cdot}008623={\cdot}050517; \\ &\therefore m-y-w+x-z={\cdot}351018. \end{aligned}$$

$$k=\frac{m}{1-n}=\log. {\cdot}351018-\log. {\cdot}84974={\cdot}5453418-{\cdot}9292861=$$

$$={\cdot}6160557=k={\cdot}4131,$$

$$w-x=1005{\cdot}425937-{\cdot}059140=1005{\cdot}366797.$$

$(w-x)-k=1005{\cdot}366797-{\cdot}4131=1005{\cdot}779897=h=$ true weight of glass apparatus *plus* nitrate of thallium *in vacuo.*

1005·779897 − 766·133831 (weight of glass apparatus *in vacuo*) = 239·646066 = weight of nitrate of thallium *in vacuo.*

239·646066 − 239·611359 (weight of nitrate of thallium in air) = ·034707 = increase in weight for vacuum.

WEIGHT OF THALLIUM.[*]

Weight of thallium taken	=	183·783921
Air displaced by thallium	=	0·018907
		183·802828
Deduct air displaced by weights..	=	0·012596
True weight of thallium *in vacuo*		183·790232

Collecting the data, we have—

		Grs.
[†]True weight of thallium *in vacuo*	=	183·790232
" " nitrate of thallium *in vacuo*	=	239·646066
" " glass *in vacuo*	=	766·133831

The reduction of the atomic weight from data obtained in the manner of the preceding weighings becomes a case of simple proportion; but the values found are absolute in so far only as the atomic weights of nitrogen and oxygen are correct. The atomic weights of nitrogen and oxygen have been usually represented by the numbers 14 and 16; but Professor Stas found these elements represented, according to observation, by 14·009 and 15·960. Therefore, oxygen (Θ_3) = 47·880, and nitrogen = 14·009, or $N\Theta_3$ = 61·889. According to the old equivalents, $NO_6=62$.

Taking as data the series of weighings *in vacuo*, the quantity of $N\Theta_3$ required to convert the thallium into nitrate is—

$$(239{\cdot}646066-183{\cdot}790232=)55{\cdot}855834 \text{ grms.}$$

We have, then, with Professor Stas's determination of the atomic weights of nitrogen and oxygen, the following proportion:—

Weight of NO_3.		Weight of thallium.		Atomic weight of NO_3.		Atomic weigh of thallium.
55·855834	:	183·790232	::	61·889	:	x;

$$\therefore x=203{\cdot}642.$$

This number, it will presently appear, represents the atomic weight of thallium as nearly as the possibility of error will allow.

Let us see what would be the atomic weight of thallium if one or other of the corrections introduced into the above determination had been omitted. The use of the old equivalent (=62) for NO_6, with the data derived from the weighings *in vacuo*, gives

$$55{\cdot}855834 : 183{\cdot}790232 :: 62 : 204{\cdot}007$$

as the atomic weight; but I cannot admit this number to be so correct as 203·642.

If we take the corrected weighings in air of ordinary density, we have, with $N\Theta_3=61{\cdot}889$,

$$55{\cdot}827438 : 183{\cdot}783921 :: 61{\cdot}889 : 203{\cdot}738.$$

With $NO_6=62$,

$$55{\cdot}827438 : 183{\cdot}783921 :: 62 : 204{\cdot}103.$$

Accepting the uncorrected weights observed in air, we have, with $N\Theta_3=61{\cdot}889$,

$$55{\cdot}8184 : 183{\cdot}8099 :: 61{\cdot}889 : 203{\cdot}800.$$

With $NO_6=62$,

$$55{\cdot}8184 : 183{\cdot}8099 :: 62 : 204{\cdot}166.$$

The several atomic weights would therefore be

203·642	204·007
203·738	204·103
203·800	204·166

The error of the last deduction, +·524, is sufficiently large to show the necessity of neglecting no precaution in chemical manipulation, especially in a determination of this character. The largeness of these errors has an immediate bearing upon quantitative analysis; for it shows that, from data ordinarily given, very varying results may be obtained. Chemists have to deal with much smaller quantities than a quarter per cent, particularly in organic analysis, where, as I have shown, such a difference from the truth may lead to very erroneous reasoning.

(To be continued).

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[*] A Paper read before the Royal Society June 20, 1872.

[*] To save needless repetition, I only give the results of these calculations.

[†] In this determination, the thallium and afterwards the nitrate of thallium were weighed in the same glass apparatus as described.

PRELIMINARY NOTICE OF EXPERIMENTS CONCERNING THE CHEMICAL CONSTITUTION OF SALINE SOLUTIONS.*

By WALTER NOEL HARTLEY, F.C.S.,
Demonstrator of Chemistry, King's College, London.

The author has been engaged in investigating the above subject during the last eighteen months, and his experiments being still in progress, he thinks it desirable to place the following observations on record :—

In the examination of the absorption-spectra, as seen in wedge-shaped cells, of the principal salts of cerium, cobalt, copper, chromium, didymium, nickel, palladium, and uranium, to the number of sixty different solutions, it was noticed that the tinctorial properties of the substances could be ascertained by noticing the absorption-curves and bands, so that, provided water be without chemical action, it could be foreseen what change would occur on dilution of a saturated solution.

The Effect of Heat on Absorption-Spectra.—When saturated solutions of coloured salts are heated to 100° C. there are—(1) few cases in which no change is noticed. (2) Generally the amount of light transmitted is diminished to a small extent by some of the more refrangible (the less refrangible), or both kinds of rays being obstructed. (3) There is frequently a complete difference in the nature of the transmitted light. Anhydrous salts not decomposed, hydrated compounds not dehydrated at 100° C., and salts which do not change colour on dehydration, give little or no alteration in their spectra when heated.

Solutions of hydrated salts, and most notably those of haloid compounds, do change; and the alteration is, if not identical, similar to that produced by dehydration and the action of dehydrating liquids, such as alcohol, acids, and glycerin, on the salts in crystals or solution.

A particular instance of the action of heat on an aqueous solution is that of cobalt chloride, which give a different series of dark bands in the red part of the spectrum at different temperatures, ranging between 23° and 73° C. Band after band of shadow intercepts the red rays as the temperature rises, till finally nothing but the blue are transmitted. Drawings of six different spectra of this remarkable nature have been made. The changes are most marked between 33° and 53°, when the temperature may be told almost to a degree by noting the appearance of the spectrum. Though to the unaided eye cobalt bromide appears to undergo the same change, yet, as seen with the spectroscope, it is not of so curious a character, the bands being not so numerous.

With cobalt iodide a band of red light is transmitted at low temperatures; this moves towards the opposite end of the spectrum with rise of temperature until it is transferred to such a position that it consists of green rays only. In this instance the change to the eye is more striking when seen without the spectroscope, because the mixtures of red, yellow, and green rays, which are formed during the transition, give rise to very beautiful shades of brown and olive green. Thus a saturated solution at 16° C. was of a brown colour, at −10° C. it became of a fiery red and crystals separated, at +10° reddish-brown, at 20° the same, at 35° Vandyke brown, 45° a cold brown tint with a tinge of yellowish green, at 55° a decidedly yellowish green in thin layers and yellow-brown in thick, 65° greenish brown, thin layers green, 75° olive-green. An examination of this cobalt salt has shown that there are two distinct crystalline hydrates; the one formed at high temperatures has the formula $CoCl_2.2H_2O$, and is of a dark green colour; the other, which contains a much larger proportion of crystalline water, is produced at a low temperature, and its colour is generally brown, in cold weather inclining to red.

The action of heat on solutions of didymium is characterised by a broadening of the black lines seen in the spectrum, more especially of the important band in the yellow; and in the case of potassio-didymium nitrate this is accompanied by the formation of a new line. In the case of didymium acetate, which decomposes with separation of a basic salt, the lines thickened on heating.

Thermo-Chemical Experiments.—Regnault (*Institut*, 1864; *Jahresbericht*, 1864, p. 99) has shown that on diluting a saturated solution of a salt, as a rule there is an absorption of heat, but in one or two cases he noticed that heat was evolved. The change in colour that takes place on the dilution of saturated solutions of cobalt iodide, cupric chloride, bromide, and acetate is very remarkable. There is every likelihood that this phenomenon is due in each case to the formation of a liquid hydrate. It is impossible of belief that accompanying such a circumstance there should be no measurable development of heat; and the author's experiments have proved that in the above cases, at any rate, the heat disengaged is very considerable; amounting, for instance, on the part of cupric chloride, at least to 2565 "units when 1 grm. molecule of the crystalline salt is displaced in its minimum of water at 16° C., and brought into contact with sufficient to make the addition of 40 Aq." These numbers only roughly approximate the truth. On diluting a solution of cobalt iodide till the red colour appears, the thermal effect must be greater, as not only does it register several degrees on an ordinary thermometer, but it may be perceived by the hand.

The conclusions indicated by these results are obvious, but it is beyond the scope of this paper to refer to them. The writer hopes before long to complete his experiments with the view of having them communicated to the Royal Society.

IMPROVEMENTS UPON EGGERTZ'S METHOD FOR DETERMINING COMBINED CARBON IN STEEL.

By EDWARD R. TAYLOR.

To relieve myself from the thraldom of monotonous routine work that would otherwise absorb nearly all my time the following improvements for the execution of Eggertz's method for determining carbon in steel were devised.

A balance, consisting of a very fine thread of glass, with a pan in two parts, one a cup and one a cone, serves to weigh the steel. A horizontal drill, with a glass tube to form a hopper, makes, and conducts the drillings of steel, as they are made, to the balance pan, which is properly supported about one-eighth of an inch above a point to which it settles, when a two hundred milligramme weight is placed in the pan. Being thus set a sample of steel is placed in the drill lathe, the drillings, as before mentioned, falling into the pan below. As soon as the two hundred milligrammes weight is in the pan, the pointer sinks to the index, when the drill is stopped. By passing a tube through a hole in the balance table, the lip of the tube offering a support for the balance cup, while the cone is pressed down with a pair of tweezers, the drillings at once fall into the tube, and are ready for treatment with acid.

A glass funnel is made, with a capillary opening at the contracted lower end. This is fused with a T tube, the lateral branch of which is passed through the window of the laboratory to remove the fumes. A rubber nipple is placed on the lower end of the T tube, into which the tube containing the steel is inserted. Three c.c. are now drawn into the funnel tube, and fall in drops upon the steel below. At the expiration of this action the tube is transferred to a bath kept at the temperature of 130° C.

At the end of twenty minutes from drawing in the acid, the operation is completed; the whole of the carbon has entered into a clear yellow solution, which has a depth of colour proportionate to the amount of combined carbon in the steel. The tubes are cooled down to a normal temperature, and compared with a series of standard colours, when it is easy to read off the amount of carbonised carbon in a given sample of steel.

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* A Paper read before the Royal Society.

The accuracy and ease of execution of this method leaves little to be desired, while it is of great value in ascertaining the amount of carbon in different specimens of steel, or the regularity of its diffusion in different parts of the same cast.

ON THE
METHODS IN USE FOR DETERMINING THE VALUE OF VEGETABLE AND ANIMAL OILS.*

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland.

(Continued from page 140).

The relative drying properties of oils is a most important point. All oils above the value of Class IV., or rape oils, mentioned in the preliminary remarks, are considered commercially as non-drying oils; but there is much reason to believe that the transition from drying to non-drying oils is not so clearly marked when accurate examination is made. The order in which the drying properties gradually develop themselves is as follows:—Animal oleins, olives, rapes, ground nut, Lisbon-seed, sunflower, cotton-seed and other fancy seed oils, and, finally, linseed oils.

This excludes the fish oils, which constitute a class to themselves, and which are generally supposed to be non-drying.

Under the name of fancy seed oils are included a number of oils we know little about, and which have, generally speaking, more drying properties than rape oil, and less than linseed oil.

Cotton-seed oil is the chief representative of this class of oils, and they seldom reach the consumer under their proper names, but are used, on the one hand to adulterate the so-called non-drying oils, olive and rape, so making them clog or gum, which interferes with their use for lubricating machinery or burning in lamps; and, on the other hand, for adulterating linseed oil, which they injure also in another direction, by spoiling its drying properties for paints and varnishes.

How far the drying properties of oils is to be measured by their relative powers of absorbing oxygen is an interesting chemical question, and the writer regrets that he has not had sufficient time to make a systematic course of experiments upon the subject, which perhaps he, or his friend Mr. Gellatly (who entertains the same views on this subject), may be able to accomplish at some future time, either by actually weighing the oxygen absorbed under similar circumstances by pure specimens exposed to, say, a temperature of 200° F. in thin layers, or by the use of some oxidising agent.

As to the practical methods of judging of the more or less drying properties of oils, we have:—

(1). The nitrate of mercury test, which indicates by the consistency of the mass subjected to the reaction. Resin oil, mineral oil, and the drying oils proper refusing to solidify.

(2). The method of comparing a sample under examination in a shallow capsule to 200° F., with a similar quantity of oil known to be pure.

(3). The imbuing thick white blotting-paper with the oil under examination, and comparing with a similar experiment with oil known to be pure at, say, a temperature of 150° or 200° for some hours, or at ordinary temperatures for some days.

We now come to the question of specific gravity. The taking of the specific gravity of an oil is one of the very first of the ideas which will occur to a chemist as a means of identification, and accordingly we find accurate experiments have been made in this direction with most of the animal or vegetable oils, and by a great number of persons, so that most chemical or technological books contain clear and valuable information on the point.

An accurate determination of the specific gravity of an oil is of consequence, and the very slipshod manner in which oil-merchants deal with the matter may be remarked. They generally employ an instrument, called an oleometer, marked with some arbitrary degrees—certain figures, standing for particular oils, marked on the stem. The defect of this instrument is its long range. From the limited length of the stem, small differences in specific gravity escape notice. The oleometer used for testing oils should be marked with the ordinary specific gravity degrees, water being 1000, and the space allowed on the stem for each degree should not be less than $\frac{1}{10}$th of an inch. This may necessitate the employment of two or three glasses for specific gravities ranging between 0·880 and the heaviest of oils. Too long a stem is inconvenient, especially when we have only small samples of oil to be tested.

Our oil-merchants are also apt to be careless about the temperature at which the gravity requires to be taken, viz., 60° F. As a rough rule for temperatures near to 60°, it is sufficiently accurate to subtract 1° of gravity for every 2½ per cent excess of temperature above 60° F., and add similarly for temperatures below 60° F. The fatty oils, however, do not all expand equally, so that it has been proposed to compare gravities at some high point, say 212° F., as a means of detecting adulterations. This suggestion may be valuable as an adjunct to other methods. The rule of 2½° F. is, however, sufficiently accurate for all normal atmospheric variations.

Having now discussed the methods which have been suggested as means of detecting adulterations, it remains for us to deal with their application to individual cases. As an indipensable preliminary to any investigation of this sort, the absence of mineral and resin oils must first be proved.

The presence of mineral oil in a mixed oil submitted to examination must not be considered as an adulteration if the oil is sold as a prepared spindle, engine, or machinery oil. In such a case, the mineral oil is probably a valuable constituent of the oil, and is added for the purpose of reducing the tendency to gumming common to most fatty oils, or else with the direct purpose of reducing the viscosity of the oil, so as to enable it to work freely upon certain classes of machinery. This prepared or mixed oil trade is legitimate. When, however, the oil is sold or offered, for instance, as a pure animal or vegetable oil, and contains mineral oil, then it becomes a case of adulteration.

Whether the presence of mineral oil be legitimate or not in the sample under examination, if it does exist there are great difficulties, for unfortunately, when mineral oil is once mixed with a fatty oil, we have no easy method of separating them without actual destruction of the fatty oils, and its presence prevents the identification of particular fatty oils.

Saponification naturally suggests itself, but practically the process is not efficient, for mineral oil unites with the soap produced, whether mechanically or chemically does not seem quite clear; at any rate, mineral oil forms an emulsion with soap solutions, which frequently show no signs of separation after standing for weeks or months.

Perhaps the formation of a lime or other earthy soap, and its reduction to powder, and the subsequent extraction of the hydrocarbons by some volatile solvent, might afford some result; but the most satisfactory method would probably be an *ultimate* chemical analysis, as the presence of mineral or resin oil hydrocarbons must wonderfully alter the relative proportions of carbon, hydrogen, and oxygen of a fatty oil.

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* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

In practice, however, mineral oil can be easily detected by two characteristic tests—

(1). The fluorescent properties it imparts to all animal or vegetable oils.

(2). The strongly marked aromatic burning flavour it communicates to mixtures containing it.

The first-mentioned property is brought out by smearing a metallic surface, such as tin-plate or steel, with the oil, and then viewing it at different angles in the open air or sunlight. So characteristic is this that most mechanics who use oil can detect mineral oil at once, even when present in very small quantities.

If, however, a chemist gets a dark-coloured oil to examine—for instance, a dark gallipoli or brown rape—it may be necessary to refine the sample by successive treatments with concentrated sulphuric acid and weak soda solution or lime-water (in the way oils are usually refined). Mineral oil can then be detected in the sample (which can be cleared by filtering through cotton-wool) by a pale azure-blue ring, about 1-16th of an inch deep, at the junction of the surface of the oil with the sides of the glass jar—the jar being held on a level with the eye, and the line of vision being at right angles to the beam of light. On looking from below upwards through the oil, the under portion of the surface of the oil exhibits a beautiful pale azure-blue sheen. It is easy to detect as small a quantity as 2½ per cent in fatty oils by this method, combined with the tasting of the oil.

The absence of resin oil must also be proved. The action of a small quantity of nitric acid is said to be a good test, the colour developed being much greater than is produced with animal or vegetable oils of any class whatever. This I have, however, only had pointed out to me just before reading this paper, and have not verified it. The presence of 10 per cent of either resin or mineral oil in samples of non-drying oils subjected to the nitrate of mercury test delays their solidification very considerably. The smell of resin oil is also frequently very perceptible.

The importance of being sure of the absence of mineral or resin oil before proceeding to test specific gravities cannot be too much insisted upon, because mineral oil, ranging in specific gravity between 880 and 900, and resin oil, being nearly 1000 adjustments in specific gravity resembling those of the natural oils, can be easily effected so as to completely upset all our subsequent classifications dependent upon specific gravity.

(To be continued.)

ON THE
VOLUMETRIC DETERMINATION OF CHLORINE WITH STANDARD SILVER SOLUTION OF POTASSIC CHROMATE.

By Prof. ALBERT R. LEEDS.

A CERTAIN small discrepancy is to be found in books with regard to the amount of potassic chromate to be employed in the volumetric determination of chlorine. According to one authority, four or five drops of a cold saturated solution of yellow potassic chromate is to be added to the solution under examination; according to a second, two or three drops; to a third, a small quantity; to a fourth, a certain number of tenths of a cubic centimetre of the standard silver solution should be deducted as the excess needed to produce a visible quantity of silver chromate. If the potassic chromate, which is sold by the manufacturers of pure chemicals, and which is usually pure enough for most purposes, were absolutely so, this discrepancy would cause no difference in the results. But as it is more or less contaminated with chlorides, it is essential in order to insure entire uniformity, to determine the number of tenths of a cubic centimetre of the silver solution, which correspond to the number of drops which are used of the particular potassic chromate solution. For example, the solution of potassic chromate contains 0·1 grm. of the salt to 1 c.c. water. 1 c.c. of this solution added to 70 c.c. of carefully distilled water, requires in a particular experiment, 0·25 c.c. of a standard silver solution, of which 1 c.c. corresponds to 0·1 mgrm. chlorine. Three drops of the chromate, as delivered from a 1 c.c. pipette, amount to 0·15 c.c. of the potassic chromate, corresponding to 0·037 c.c. of the silver solution. To 70 c.c. of an unknown solution containing chlorine, 0·15 c.c. of the chromate are added. In a number of trials the same number of c.c. of silver solution are required in each case, viz., 2·8 c.c. Subtracting 0·037 c.c. leaves, for the true number, 2·76 c.c.—*American Chemist.*

ESTIMATION OF MANGANESE IN SPIEGEL EISEN.

By ARTHUR WILLIS, F.C.S.,
Chemist to the Landore-Siemens Steel Company (Limited).

HAVING had considerable experience in the estimation of manganese in spiegeleisen, steel, and pig-iron, I venture to suggest the following modifications of the method given in the CHEMICAL NEWS, vol. xxix., p. 110:—

If, after evaporating in dilute hydrochloric (for steel and pig-iron) or dilute nitric (for spiegeleisen), and re-dissolving in aqua regia, the solution be transferred to a flask (instead of a beaker), and the solution neutralised in the cold, the following difficulties are overcome:—

(α). The liability to froth over.

(β). The necessity of stirring in order to prevent the vessel from cracking. This continued stirring would be totally impossible if one had six or eight experiments proceeding simultaneously.

The precipitate of basic acetate of iron will always require rather more washing than your correspondent advises, as he will find if he take the trouble to re-dissolve his precipitate, and repeat the whole operation; in fact, it is very seldom that a little manganese is not left, even after very copious washing. In all accurate determinations, therefore, the precipitate should be dissolved up, and the process repeated.

If a rather larger quantity of bromine and ammonia than your correspondent advises be added to the filtrates (from the first and second precipitation of the iron, mixed in one flask), there will be no necessity to set aside for eighteen hours. In order to throw all the manganese out of solution, it may be boiled at once, and filtered. The whole operation takes but four hours, including a re-solution of the acetate of iron, and with proper appliances a dozen may be done in nearly the same time.

ON THE METHODS OF ANALYSING WATER.*

By FERD. TIEMANN.

(Concluded from page 129).

III. *Methods which Determine the Amount of Nitric Acid by Measurement of the Nitric Oxide Evolved.*

1. This principle was first applied by Walter Crum. His method, and the modification devised by Frankland and Armstrong, depend on the decomposition of the nitrates in a very concentrated solution by an excess of concentrated sulphuric acid, and on the conversion of the nitric acid set free into nitric oxide by agitation with metallic mercury. The gas is either measured in the generating-tube or, according to Frankland, is transferred to a gasometrical apparatus. Compounds of chlorine must not be present, and must be removed by a preliminary admixture of the concentrated water with a solution of the sulphate of silver. The decomposition of the nitrates,

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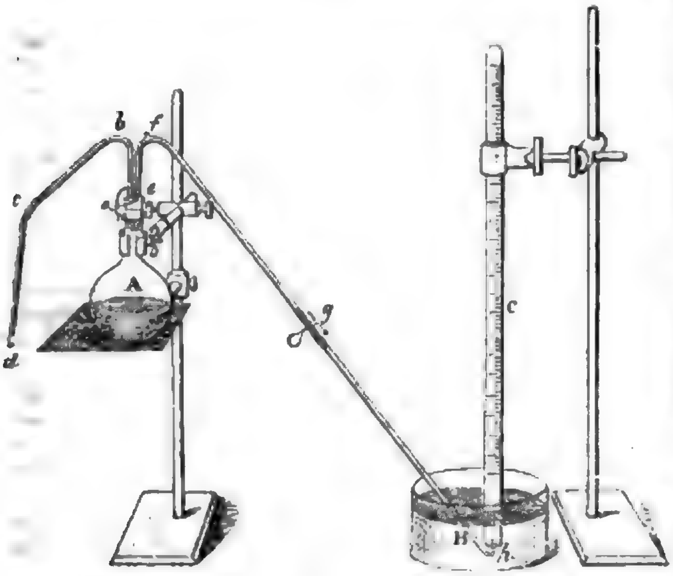
* Abstract of a Paper from *Ber. d. Deut. Chem. Ges. zu Berlin.*

when small in amount, is a tedious process; the concentration of a large bulk of water down to 1 or 2 c.c., the transfer of the latter to the decomposition-tube, the precipitation of the chlorine by means of sulphate of silver, and the accompanying filtration are unpleasant operations.

2. Schulze modified this method by decomposing the nitrates in the concentrated water with hydrochloric acid and protochloride of iron, receives the nitric oxide liberated by the application of heat over moist mercury, and introduces it finally into a graduated tube, in which it is measured. The results are accurate, and the presence of organic substances does not interfere.

The author has modified this method as follows:—100 to 300 c.c. of the water are evaporated down to 50 c.c., and these, together with the alkaline earthy carbonates separated out by boiling, are placed in a flask, A, containing about 150 c.c If portions of the precipitate adhere to the evaporating-basin, they are repeatedly washed with distilled water, but it is not necessary to bring them entirely into the flask, A. This is provided with an india-rubber stopper having two apertures, through which pass two bent tubes, *a b c* and *e f g*. The former is drawn out at *a* to a point not too fine; it passes through the stopper for the depth of about 2 centimetres. The other tube ends exactly at the under-side of the stopper. Each of them is connected at *c* and *g*, by means of india-rubber tubes, with the glass tubes *c d* and *g h*, and provided with pinchcocks at these connections. Over the lower end of *g h* a piece of india-rubber tube is drawn, to protect it from breaking. B is a glass trough filled with soda-lye at 10 per cent. C is a measuring-tube, narrow, filled with well-boiled soda-lye, and graduated into $\frac{1}{10}$ c.c.



The concentrated water is boiled for some time in A, both tubes being open. Towards the end of the operation, the lower end of *e f g h* is placed in the soda-lye, and the vapours of water are allowed to escape through it. After some minutes, the india-rubber tube at *g* is compressed with the fingers; if the air has been completely expelled from the apparatus, the soda-lye rushes up from B as if into a vacuum, and a slight shock is felt in the fingers. In this case, the pinchcock is put on at *g*, and the vapours are allowed to escape by *a b c d* until only about 10 c.c. of liquid remain in the flask. Then the flame is withdrawn, a pinchcock is fixed at *c*, and the tube *c d* is filled with water. If a bubble of air remain in the india-rubber tube at *c*, it must be removed by pressure with the fingers. The tube C is now fixed over the lower end of *e f g h*, which should project up slightly into C. We wait then a few minutes till, as the flask cools, a vacuum in the interior of the flask is manifested by the collapse of the india-rubber tubes at *c* and *g*. Solution of protochloride of iron, nearly saturated, is poured into a small beaker marked at 20 c.c., and two other glasses, filled with concentrated hydrochloric acid, are placed in readiness. The tube *c d* is then placed in the iron solution, the pinchcock at *c* opened, and 15 to 20 c.c. of the solution allowed to flow in. The latter is cleared out of the tube by twice allowing small quantities of hydrochloric acid to enter. Gentle heat is now applied to the flask, A, by means of a Bunsen burner, till the india-rubber tubes begin to swell at *c* and *g*. The pinchcock at *g* is now replaced by the fingers, and, as soon as the pressure grows stronger, the nitric oxide is allowed to pass over into C. Towards the end of the operation, we increase the heat, and distil as long as the volume of gas in the tube increases. All hydrochloric acid gas is eagerly absorbed by the soda-lye. After complete expulsion of the nitric oxide, the tube *g h* is removed from the graduated tube, C, and the latter is placed in a large cylinder filled with cold water (15° to 18° C.). After the lapse of twenty minutes, the volume of nitric acid can be read off. It is reduced to the temperature of 0° and the barometric pressure of 760 m.m., and the corresponding quantity of nitric acid is found by calculation. The space taken up by the nitric oxide, answering to 1 milligrm. nitric acid (N_2O_5) at the temperature and pressure just mentioned, is 0·41 c.c. The amounts of chloride of iron and of hydrochloric acid used should not be too large.

IV. *Methods depending on the Oxidising Action of Nitric Acid upon a Solution of Indigo.*

1. Marx mixes 50 c.c. of the sample with 100 c.c. pure sulphuric acid, and adds a dilute solution of indigo till the liquid takes a green colour. The value of the indigo solution is ascertained by a previous experiment with a solution of nitre of known strength.

2. Trommsdorf takes 25 c.c. of the water and 50 of the acid, finds approximately the amount of indigo solution by a preliminary experiment, and in the final assay is thus enabled to manipulate more rapidly, and escape an error which arises from prolonged action.

Goppelsrœder proceeds in the preliminary trial like Marx, adds in the final assay nearly the quantity of indigo required *before* the sulphuric acid, and then a further amount of indigo until the green colour appears. An equal quantity of acid by this means decolourises a greater amount of indigo.

Van Bemmelen mixes the water first with the indigo solution, adds 1½ to 2 volumes of sulphuric acid, and finds by repeated trials the exact amount of extra indigo solution needful to give the green shade.

Finkener mixes 50 c.c. of water with 33 of acid, heats the whole to 122° to 125° C., and titrates with the indigo liquor.

Fisher allows the water to flow into a mixture of indigo liquor and sulphuric acid.

In all these processes, the presence and amount of chlorides has a modifying effect. The presence or absence of organic matter, the temperature, and the duration of the operation are also influential.

Of these methods, the author prefers Trommsdorf's; he uses an indigo-liquor of which 6 to 8 c.c. = 1 milligrm. N_2O_5, and takes for the trial quantities of water containing not more than 3 to 4 milligrms. nitric acid in 25 c.c. If the water is richer in nitrates, it is diluted with known quantities of distilled water free from nitrates. The author, summing up, pronounces the method of Schulze and those of Reichard and Trommsdorf the most generally applicable. That of Schulze, as modified by the author, gives under all circumstances the most accurate results.

Popular Chemistry.—We extract the following from the *Family Herald*, March 21, 1874:—"To detect nitric acid in wines, it is necessary to saturate the wine with baryta, and then distil; phosphoric acid is added to the residue and re-distilled, when the acetic acid will be found in the distillate."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The President said that the duty devolved upon him to lay before the Fellows of the Society an account of the changes which had taken place since their last Anniversary Meeting. At that time there were 688 Members, 70 had since been elected, and they had lost 19 by death and retirement; so that at present there were 739 Fellows, being an addition of 51 to their numbers. They had also lost one of the Foreign Members, of whom there were now 31. (The President then read short biographical notices of the following members who had died during the past year:—Baldwin Francis Duppa, Frederic Crace Calvert, Henry Bence Jones, William Husskisson, jun., Charles Davy, William John Hay, and Daniel Stone.) The Foreign Member whom we had lost was Justus Liebig, the worker who, by his discoveries in organic chemistry, and through the pupils he had educated in that department of science, had mainly contributed to raise German chemistry to the place it now occupies. It was proposed that early next session Dr. Hofmann should deliver the third Faraday lecture, being a "Discussion of the Early Work of Liebig." It was the pleasant duty of the late president to congratulate the Fellows of the Society on the increase of the number of papers—from twenty-two in 1872 to fifty-eight in 1873. During the past year the number had been 51, in addition to the four lectures. Dr. Odling called attention to the fact, which did not appear to be very generally known, that the Society made small grants to assist experimental chemists in the prosecution of original research, and that the Royal Society has the means of making larger grants for the same object. There are also in Oxford and Cambridge many scholarships of the value of from £200 to £300 a year each for the encouragement of chemical science, besides a number of Fellowships of about the same value devoted to the same object. He could not allow the occasion to pass without congratulating the Fellows on their taking possession of their new apartments. The meeting-room was not quite so satisfactory as might be wished, but the Council hoped to remedy its defects as far as possible. The preparation-room, although as yet unfurnished, would doubtless be of the greatest value at a future time in illustrating the papers read before the Society, for chemistry was essentially a science of phenomena which could be observed. The President then discussed the pecuniary affairs of the Society, which are very satisfactory, notwithstanding the heavy expenses necessarily incurred in removing into the new rooms; at the same time, it must be remembered that these will entail a considerably increased annual expenditure. He also noticed the various improvements, and the proposed extension of the library by the completion, where possible, of the various sets of serials, and the purchase of standard works. Attention was also called to the "Complete Index of the Journal of the Chemical Society," from its commencement, which valuable work has just been finished by the Editor, Mr. Henry Watts.

The Treasurer having given his report of the financial state of the Society, the President read the bye-law relating to the election of Officers, which was then proceeded with, Messrs. Neison and Wills acting as scrutators.

The following is the list of Officers and other Members of Council elected for the ensuing year:—

President.—W. Odling, M.B., F.R.S.

Vice-Presidents who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; E. Frankland, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S. A. W. Williamson, Ph.D., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents.—J. H. Gladstone, Ph.D., F.R.S.; A. Vernon Harcourt, M.A., F.R.S.; G. D. Longstaff, M.D.; H. E. Roscoe, Ph.D., F.R.S.; Maxwell Simpson, Ph.D., F.R.S.; A. Voelcker, Ph.D., F.R.S.

Secretaries.—W. H. Perkin, F.R.S.; W. J. Russell, Ph.D., F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Other Members of Council.—J. Attfield, Ph.D.; H. E. Armstrong, Ph.D.; Dugald Campbell; J. Dewar, F.R.S.E.; A. Dupré, Ph.D.; G. C. Foster, F.R.S.; M. Foster, M.D., F.R.S.; Peter Spence; Hermann Sprengel, Ph.D.; Thomas Stevenson, M.D.; R. Warington; C. R. A. Wright, D.Sc.

Dr. Warren De la Rue then proposed a vote of thanks to the President, which was seconded by Mr. W. Thorp. The Officers and Council were proposed by Dr. Stevenson, seconded by Mr. A. Tribe, Dr. Russell, the junior Secretary, thanking the Fellows in their name. A vote of thanks to the Auditors was then proposed by Professor Abel, and seconded by Mr. C. E. Groves; and one to the Editor of the Journal and the Abstractors by Dr. Hugo Muller, seconded by Dr. Warren De la Rue, to which Mr. Henry Watts responded.

The meeting was then adjourned until Thursday, April 2nd.

NOTICES OF BOOKS.

The Laboratory Guide, a Manual of Practical Chemistry, specially arranged for Agricultural Students. By A. H. Church, Professor of Chemistry in the Agricultural College, Cirencester. Third edition, enlarged and revised. London: J. Van Voorst.

This useful manual of analytical chemistry as applied to agriculture is already favourably known. The present edition has been enlarged by the addition of some fifty pages. Certain portions have, further, been re-arranged, as will be seen on comparing the tables of contents in the present and in the former edition. The general methods laid down for the analysis of bone-ashes, superphosphates, coprolites, &c., are unaltered. The "fusion method" is recommended for the determination of phosphoric acid in Sombrero and Redonda guanos, as well as in certain nitrogenous guanos, such as those of Guanape, Ballestas, &c. In speaking of "reduced" phosphates, the author disputes the theory that they are equal in value to those which remain soluble. Even though all soluble phosphates do ultimately become reduced in the soil, yet, by being at first presented in a soluble state, they possess an "initial diffusive power" which reduced phosphates lack. The former consequently are distributed through the soil more equally, and the chances are greater that every rootlet of the crop will be able to find a particle of phosphate of lime in immediate contact with its pores.

This reasoning is perfectly correct, and agrees with what we have repeatedly heard advanced by experienced and judicious agriculturists and manure-makers.

In estimating the "soluble phosphate" in superphosphates, the student is very properly cautioned against extracting with hot water. In fact, lixiviation with small successive portions of cold water is preferable to treatment at once with a larger volume.

The uranium methods, gravimetric and volumetric, of determining phosphates are described in detail.

We were somewhat surprised at the statement that blue vitriol is "often fraudulently employed by bakers." As far as we have been able to ascertain this fraud is decidedly rare in England.

To students of agricultural chemistry, and to all interested in the knowledge of soils and manures, this "Laboratory Guide" may be safely recommended.

Chimie Inorganique Elémentaire. Par Edouard Grimaux, Professor Agrégé à la Faculté de Médecine de Paris. Paris: Germer Baillière.

This work consists of a series of lectures delivered at the Faculty of Medicine. Its speciality lies in the fact that, after a brief explanation of what is meant by simple and compound bodies, and what is the nature of chemical action, the author proceeds at once to the consideration of the individual elements and of their compounds, explaining all theoretical points as they successively arise. M. Grimaux is one of those chemists who consider tin not to be a metal. If we reflect that it was one of the six bodies a survey of whose properties gave rise to the idea of a metal, its exclusion from that class seems to us no less paradoxical than would be the banishment of sodium chloride from the class of salts, olive oil from that of oils, or spirit of wine from the alcohols. It is perfectly true that the higher oxide of tin is capable of playing the part of an acid. But so are the oxides of not a few other bodies whose place among the metals is hitherto undisputed.

Peroxide of tin, further, is capable of acting as a mordant along with colouring matters of a feebly acid character, as well as of combining with powerful acids. Its claims to the nature of an acid are, therefore, no stronger than those of alumina, and far inferior to those of the chromic and manganic acids.

Is it not time for the old binary classification of metals and non-metals—or metalloids, as the French most unhappily call the latter—to be thrown aside?

The descriptions are clear and full, and the illustrations are numerous, but not a few of the elements are altogether omitted. This strikes us as a mistake. The work is written from a medical point of view, and is mainly addressed to medical students. Now, a body too rare to be of technological importance may still, as a poison or a remedy, merit the attention of the physician. Chemically speaking, the omission of any known element is unjustifiable.

The work concludes with a brief outline of qualitative mineral analysis. The value of the index is impaired by a considerable number of typographical errors.

CORRESPONDENCE.

ON AN ALLEGED REDUCTION OF CARBONIC ACID TO CARBONIC OXIDE.

To the Editor of the Chemical News.

Sir,—Some time ago a notice from E. N. Horsford went through various chemical journals, stating that carbonic acid would be reduced to carbonic oxide by exposing it, with protophosphate of iron, to the sunlight, and that this process would be very important in the process of vegetable life. Although I had considerable doubt about the truth of this statement, I repeated the experiment exactly as stated by Horsford. After three weeks' exposure to the sun the gas was tested, and found to be plain carbonic acid; not the *slightest trace* of carbonic oxide could be detected. As a general thing I found no iron salt capable of having any reducing influence upon carbonic acid.—I am, &c.,

E. Shepherd.

Baltimore, March 10th, 1874.

MISCELLANEOUS.

The Jubilee Volume of "Poggendorff's Annalen der Physik und Chemie."—We have great pleasure in calling the attention of our readers to the special volume of the *Annalen*, about to be issued. For fifty years this valuable journal has been edited by J. C. Poggendorff. In commemoration of so unprecedented an occurrence, the friends and admirers of the editor have combined to produce a "jubilee volume," distinguished alike by the character of its contents and by the elegance of its appearance. When we call to mind the eminent merit of Dr. Poggendorff and the European reputation of the *Annalen*—associated as they have been for half a century with the foremost names in physical and chemical research,—we can do no other than express our cordial approbation of the undertaking and our best wishes for its success. England ought not to fall behind any country in the number of subscribers to this commemorative volume. We are deeply indebted to Dr. Poggendorff, and it is but just that we should do him honour.

Expansion by Heat.—In prosecuting experiments to ascertain the expansion of various substances by heat, the following experiment was tried:—The bulb of a thermometer was suddenly plunged into melted lead. The mercury instantly darted down far below zero. The action was so quick that the point could not be ascertained. This was caused by the sudden expansion of the bulb by heat before it reached the mercury by conduction; this then began to rise very rapidly, and before it had arrived at the top of the tube the bulb was withdrawn. The experiment requires adroitness, for, as we all know, the instant that the mercury touches the top, the bulb will burst. This must be greased before immersion in the fused lead, otherwise a film of the metal will adhere and retain sufficient heat to carry the mercury to the top with a consequent fracture. A thermometer treated in this rough manner afterwards showed an index error of six degrees, the mercury having risen to that extent; but after a few days the equilibrium was partly restored, and the error remained permanently at three degrees.—*Engineering and Mining Journal.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 9, 1874.

Experimental Study in Interior Ballistics.—Gen. Morin.—The author indicates a graphic method of determining the motor forces exerted at different points in the course of a projectile through the bore of a gun for powder and for gun-cotton. He also gives a representation of the law of variation of the motor forces, or interior pressures, in function of the lengths of the bore traversed, and examines the curves obtained from different explosive substances.

New Clinical and Experimental Researches on the Movements and Rest of the Heart, and the Mechanism of the Course of Blood through its Cavities in the Normal State.—M. Bouilladn.—The author points out the resemblance between the action of the heart and that of a suction- and forcing-pump, as regards both structure and function. The hearts of various animals were laid bare, and observed with eye and hand. One curious result obtained was that (contrary to what is taught) the revolutions of the heart do not commence with the same movements in animals having only one ventricle and those having two. In the latter (of which man is an example) they begin with ventricular systole and auricular diastole. In univentricular animals (such as frogs and tortoises) they begin with ventricular diastole and auricular systole. M. Bouilland also points out that, like the arteries, the heart is a four-timed instrument, having two movements and two times of rest. If we give the name of *pulse* to its beats, as we do to those of the arteries, the pulse of the heart in the normal state is *dicrotous*, like that of the arteries, and not *monocrotous* as has hitherto been taught.

Observations at the Observatory of Tolouse.—M. Tisserand.—A table of the eclipses of Jupiter's satellites during 1874.

Observations of Aurora Borealis on February 4, 1874, at Toulouse.—M. Tisserand.

Memoir on the Problem of Three Bodies.—M. Mathieu.

Resistance of Glass Tubes to Rupture.—M. Cailletet.—The author has been led to study the subject in his researches on the compressibility of gases. His conclusions are—(1) That a glass vessel is broken much more easily by an interior pressure than by an exterior. Thus, a vessel of glass 0·55 m.m. thick, and 17 m.m. diameter, was crushed under a pressure of 77 atmospheres; whereas an interior pressure of 38 atmospheres was sufficient to burst it. (The pressures were produced through liquids.) (2) That the quantities by which the volume of the vessel varies are proportional to the pressure, at least within wide limits, especially where this pressure is exerted on the exterior. Thus, in one case, the rise of liquid in a capillary tube forming part of a vessel of glass (1·05 m.m. thick, 9·05 m.m. internal diameter) subjected to exterior pressure was 6 m.m. per 20 atmospheres, and the experiment was continued up to 460 atmospheres, the rise throughout being proportional to the pressure. M. Cailletet has succeeded in constructing a very sensitive manometer based on these properties of glass.

Employment of a Birefringent Prism for Determination of the Axes of Ellipses.—M. Janettaz.

New Supernumerary Bands Produced in Solutions of Chlorophyll under the Influence of Sulphuretted Agents.—M. Chautard.—If chlorophyll be dissolved in sulphide of carbon, or an alcohol solution be made of chlorophyll from certain Cruciferæ (cabbage, *e.g.*) with a little ammonia added, and the solution be kept a few months in the dark, there appears, in the part of the spectrum more refrangible than the red, a very fine pale band in addition to the *specific* band of the red, which remains in its place intact. This peculiarity may sometimes be of importance in the search for chlorophyll in excrementitious matters which often contain sulphuretted elements, naturally giving rise to the appearances indicated.

Principles of the Flight of Birds.—M. Bertin.—An instructive paper, hardly suitable for abstraction.

Volcanic Phenomena of Nisyros.—M. Gorceix.

Safety Electric Cable against Fires.—MM. Joly and Barbier.—Two wires, insulated from each other by gutta-percha, are corded together into a cable, and are connected at one end with a battery and electric bell. When fire breaks out in any part of the building through which the cable passes the gutta-percha is freed and the wires come into contact, thus closing the circuit and ringing the bell. The condition of the apparatus is tested by means of a peg commutator at the other end of the cable.

Measurement of Heat.—M. West. (Extract.)—The author investigates the relations between calorimetry and thermometry. He made use of the best data of science to calculate the exterior mechanical effect of a caloric applied to raise, from zero to 1° C., first nitrogen, then hydrogen, and he got for these two kilogrammetric quantities closely agreeing. This being the case, notwithstanding the inequality of distance of these gases from their point of liquefaction and general difference of physical properties, it follows that whenever a caloric is applied to one of the gases considered perfect, and at unequal distances from the liquefying point, it produces the dilatation at zero, and, conversely, when a scale of temperature is graduated by the aid of volumes which are in constant relation to one another, this scale will indicate, for each division, the same number of calories. The author has calculated a manual of correspondence for passing from the ordinary scale of temperatures to a proposed scale, this manual being extracted from a comparative table of two series of volumes of hydrogen gas.

M. Croce Spinelli announced his intention of making a balloon ascent, in which he would take with him a supply of oxygen for breathing in the rare upper regions.

The Winter of 1874.—M. de Tastes.—The author holds the theory that there is a large air-current, an aërial river, accompanying the Gulf Stream, passing over Northern Europe, then going south over the east of Europe (becoming more and more dry during its progress) and entering tropical Africa, and probably uniting with the north-east trade-winds on the east coast, while the equatorial current is a returning branch. Vortical movements arise from friction of the current with the comparatively calm mass of air forming (in our hemisphere) the left bank of the river, where these movements are opposite to that of the hands of a watch. The river has its floods and its abatements; during the former the whirlwinds are more frequent and intense. The aërial circuit circumscribes a mass of air having higher atmospheric pressure than the body of the current, and which is to the current what the *Sargasso* sea is to the Gulf Stream. In this *zone of calms* the air has only irregular movements from causes purely local, or eddies in its circumference. Its extent varies with the amplitude and force of impulsion of the surrounding river, sometimes being compressed within the limits of Central Europe, when the isobaric maps show a series of irregular concentric circles, the gradient decreasing from the centre to the circumference, about a true centre of compression. The character of our winters is, in great measure, determined by the situation and extent of this zone of calms. If it rests on the Mediterranean and the north of Africa (the most ordinary case) the bed of the equatorial current extends over the British Isles and the north-west of France, and we have mild and rainy winters. If the zone of calms is carried further to the south the current bends eastwards towards Spain and the Mediterranean. France is then on the left bank, and the cold air of northern latitudes comes to it. It is then we have the intense winters, which, fortunately, occur only twice or thrice in a century. Lastly, the equatorial may have such a force of impulsion that it approaches Europe by the north of Norway and Lapland, letting the zone of calms cover Central Europe. Cold weather may then occur in our latitudes, but it is due to excess of nocturnal cooling over the weak insolation of our short days. We are then on the right bank of the current, separated from polar colds by its whole breadth. The winter is moderately cold, the rains are rare, fogs abundant, winds weak, and our watercourses fall. This is precisely the character of the present winter.

Chemical Characters of the Uredo of Maize, and on Certain Questions of Vegetable Analysis.—M. Hartsen.—Under the influence of this parasite the grain is transformed into an oval bladder filled with a brown or reddish powder. The colouring matter is not extracted by absolute alcohol, ether, benzol, petroleine, chloroform, acetic acid, caustic potash, &c. It is perfectly inodorous even at 100° C., but if boiled in water it gives off a disagreeable and bituminous odour. If the vapours are condensed they form an offensive liquid, which if allowed to stand for twenty-four hours, deposits drops of a camphor-like matter of a crystalline structure. When treated with nitric acid the uredo gives off an odour of bitter almonds, whilst oxalic and suberic acids and a considerable quantity of grease are formed. Precipitated sulphuret of lead absorbs and retains many substances, such as resins, colouring matters, &c. In decolourising power it scarcely yields to animal charcoal, and, in certain cases, is even preferable. It deserves attention whenever the acetate of lead is used to isolate acids and other vegetable matters. After having decomposed the precipitate with sulphuretted hydrogen, the sulphuret of lead should not be thrown away until it has been exhausted with boiling alcohol. In the extraction of chlorophyll benzol may be used instead of ether, the leaves being previously soaked in alcohol.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, January 26, 1874.

Deacon's Chlorine Process.—R. Hasenclever.—The author remarks that Weldon's process can be carried on without particular difficulty, and without any especial superintendence—points of great importance on account of the large scale of the English alkali works. On the other hand, the apparatus for Deacon's process requires care in its construction, preservation, and working. The chloride of lime produced by this process was formerly too weak, and the consumption of coal was high. Now the chloride of lime contains 35 per cent of available chlorine, and the fuel consumed amounts to half the weight of the finished product. The chlorine obtained by Deacon's process is so diluted with nitrogen and air that for perfect absorption the surfaces covered with lime is six times larger than in the ordinary chloride of lime works. The introduction of the process is rendered costly by these extensive chambers. On the other hand, the amount of labour is trifling, the consumption of fuel moderate, and manganese is entirely dispensed with. Deacon's process is well calculated to remove the hydrochloric acid nuisance from the air and the rivers.

Aromatic Phosphorus Compounds. (Third communication.)—A. Michaelis.—This paper is not adapted for abstraction.

On Carbo-Diphenylimid.—W. Weith.—This substance, $C_{13}H_{10}N_2$, consists of—

Carbon	80·41
Hydrogen	5·15
Nitrogen	14·44
	100·00

It is sparingly soluble in benzol, and melts between 168° and 170°. The author has examined its behaviour with hydrochloric acid, water, aniline, and sulphuretted hydrogen.

Constitution of Anthracen.—Arno Behr and W. A. van Dorp.—A hypothetical paper.

Diallyl Derivatives.—Louis Henry.—The author investigates propargyl octobromide, and the tetrabromide of bibromated diallyl, $(C_6H_8Br_2)Br_4$.

Constitution of Parabanic Acid, and the Synthesis of its Homologues.—N. Menschutkin.—A preliminary notice.

Sulphur Compounds of Selenium.—H. von Gerichten.—An examination of the compounds SSe_2, SeS_2, AS_2SeS_2, and AS_2SSe_2. Analogous antimonial compounds are still under examination.

Neutralisation-Heat of the Oxides of Lanthanum, Cerium, Didymium, Yttrium, and Erbium.—Julius Thomsen.—The author finds that the hydrates of these oxides approach the most powerful bases as regards their heat of neutralisation.

On Methyl-hydantoinic Acid.—E. Baumann and F. Hoppe-Seyler.—The authors, taking up the incomplete researches of the late A. Schultzen, caused an aqueous solution of sarkosin to act upon cyanate of potash and an equivalent of sulphate of ammonia, and obtained methyl-hydantoinic acid—

Carbon	36·36
Hydrogen	6·06

This acid is not very readily soluble in cold water or alcohol, but readily soluble in both with the aid of heat, as also in ether, whether aqueous or alcoholic. It has a strong acid reaction and a pleasant sour flavour. Along with this acid were found undecomposed sarkosin, urea, and methyl-hydantoin. Hydantoinic acid may also be obtained by boiling a solution of glycocoll and urea with excess of baryta water till no more escape of ammonia is perceived. Sarkosin, also, if boiled with urea and baryta.

On Nitrophenol and Dinitro-Benzol.—H. Salkowski.—A note on the "relative position of the groups to be substituted" in the benzol derivatives.

Glucino-chloride of Palladium.—A. Welkow.—This salt is composed of—

G	1·99
Pd	22·44
Cl	45·09
H_2O	30·48
	100·00

and its formula is $G.PdCl_6+8H_2O$. At 130° it loses all its crystalline water, and when heated further proves tolerably permanent. The corresponding platinum salt loses only the half of its crystalline water. The remainder only escapes above 150°, the compound being simultaneously decomposed.

Action of Iodide of Methyl upon Diamido-Benzoic Acid.—Peter Griess.—The author has examined free hexa-methylated diamido-benzoic acid, $C_7H_2(CH_3)6N_2O_2$; hydriodate of hexa-methylated diamido-benzoic acid, $C_7H_2(CH_3)_6N_2O_2,2HI+H_2O$; hydrochlorate,—

$$C_7H_2(CH_3)_6N_2O_2.2HCl+4H_2O;$$

carbonate, $C_7H_2(CH_3)_6N_2O_2,CH_2O_3+3H_2O$; and the platinum double salt,—

$$C_7H_2(CH_3)_6N_2O_2,2HCl,PtCl_4,+H_2O.$$

Synthesis of Phenanthren from Toluol.—C. Graebe.—The author, on repeating Berthelot's experiment, by the passage of toluol through a red-hot tube, obtained phenanthren in addition to the anthracen and other products mentioned by the French chemist.

Action of Heat upon Methyl Diphenylamin.—C. Graebe.—One portion of the methyl diphenylamin is converted into diphenylamin and carbazol. Another portion yields benzol, aniline, and cyanphenyl.

Diphenylen-Sulphide and Diphenylen-Disulphide.—C. Graebe.—The author considers this compound identical with the para-phenylen-sulphide of Stenhouse, and ascribes to it the formula $C_{12}H_8S$. Diphenylen-disulphide, $C_{12}H_8S_2$, he considers to be the phenylen-sulphide of Stenhouse.

Derivatives of Diphenyl.—G. Schultze.—The author has obtained and examined nitro-diphenyl, $C_{12}H_9NO_2$; amido-diphenyl, $C_{12}H_9NH_2$; bromnitro-diphenyl,—

$$C_{12}H_8BrNO_2;$$

and iso-amido-nitro-diphenyl, $C_{12}H_8NO_2NH_2$.

Derivatives of Paranitro-toluol-sulphuric Acid.—Fr. Jansen.—The author has formed and examined a number of derivatives of this acid.

Constitution of the Benzol Bodies.—Th. Petersen.—A continuation of the author's hypothetical studies on this subject.

On Eucalyptol.—A. Faust and J. Homeyer.—The authors find the eucalyptol of Cloëz to be a mixture of a terpen and cymol.

Decomposition of Dichlorallylen into Acrylic Acid.—A. Pinner.—The contents of this brief paper are sufficiently plain from the title.

Chlorhydrins, or Basic Chlorides of the Polyatomic Radicals.—Louis Henry.—A critique on a paper on the same subject (*Berichte*, bd. vi., p. 1023) with reference to earlier demonstrations of the alcoholic nature of the chlorhydrins.

Specific Gravity and Volume of Iodic Acid, and the Solutions of Periodic Acid.—Julius Thomsen.—A physical paper. The author finds that a contraction takes place when solutions of iodic acid are mixed with water. With periodic acid this is not the case.

Preparation of Peroxide of Hydrogen.—Julius Thomsen.—Peroxide of barium in fine powder is added to dilute hydrochloric acid almost to saturation. To the solution, cooled and filtered, baryta water is added till the silica and the extraneous oxides have been thrown down, and a faint precipitate of hydrated peroxide of barium is formed. The liquid is then filtered, and baryta water added in quantity, when crystalline hydrated peroxide of barium is thrown down. The precipitate is filtered, and washed till the washings are free from hydrochloric acid, and is preserved in the moist state in closed vessels. To prepare peroxide of hydrogen this moist hydrate is added to dilute sulphuric acid with constant stirring. This is continued till only a trace of free acid remains. The sulphate is then allowed to subside, and the liquid is filtered. The filtrate is freed from traces of sulphuric acid by the cautious addition of dilute baryta water.

On Glucino-Platino-Chloride.—Julius Thomsen.—The author points out that he anticipated Welkow in describing this salt.

Influence of Temperature on the Development of Heat during Chemical Reactions.—Alex. Naumann.—A question of priority.

Dissimilar Behaviour of Isomeric Nitramines under the Action of Alkalies.—P. Wagner.—This paper is not adapted for abstraction.

On Cœrulignon.—A. W. Hofmann.—The analysis of a crystalline specimen showed $C_{16}H_{16}O_4$. Further investigations are announced.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for smelting zinc, and apparatus therefor. John Imray, 20, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Oscar Loiseau, engineer, Ougree, Liège, Belgium). May 5, 1873.—No. 1623. This invention relates to a process and apparatus for smelting zinc oxide ore. The ore, mixed with carbonaceous powder, is placed in a heated oven situated over a furnace charged with coke or other carbonaceous matter. This furnace is supplied with air preferably heated in such limited quantity as to generate carbonic oxide, which is led hot through the oven above. The ore is thus reduced, and zinc vapour is carried by the gases through exposed passages, wherein it is condensed, and from the bottoms of which liquid zinc flows. The condensation of the zinc is aided by keeping the gases under pressure, which is effected by forcing air into the generating-furnace, and making the gases, at their final escape, pass a loaded valve. In escaping, the gases bubble through water, whereby any portions of zinc vapour are condensed, and they may then be led to a boiler or other furnace, where such [*combustible*[*]] ingredients as they may contain can be utilised as fuel. Steam may be introduced into the oven along with the reducing gas.

Improved process for bleaching jute and other textile fibres, and for preparing the same for the reception of colours, and for the manufacture of paper. John Frederick William Hodges, chemical assistant, Belfast, Ireland. May 8, 1873.—No. 1672. The yarn or cloth is first steeped into a weak solution of an alkaline carbonate for two hours, and afterwards boiled for two hours; it is then steeped for one hour in a weak solution of hydrochloric acid, and then washed. It is afterwards placed in a solution of an alkaline carbonate, then in a solution of oxychloride of magnesium, and finally steeped in weak hydrochloric acid, and then well washed and dried.

Improvements in treating sewage in order to produce manure therefrom. Eugene Moriarty, house steward, Portobello Road, Notting Hill, Middlesex. (Partly a communication from Jacques Jules Renous Ceré, Brussels, Belgium). May 9, 1873.—No. 1686. Sewage is treated with plaster or sulphate of lime, tar, wood charcoal, acid phosphate of magnesia, and phosphate or sulphate of iron, ammonia, sulphur, saltpetre (nitrate of potash), phosphoric acid, and nitrate of soda.

Improvements in the purifying of crude anthracen of commerce. Charles Caspers, Newcastle-on-Tyne, Northumberland. May 9, 1873.—No. 1689. This Specification describes taking crude anthracen from which all oily matters have been separated as far as possible by mechanical means, and washing it with light oil for one or more times, and finally washing with methylated spirit. The anthracen thus purified is afterwards kept heated at about 100° C. to dry it thoroughly. Or after washing it with light oil the partially-purified anthracen may be dissolved by the aid of heat in a fresh quantity of light oil, and when allowed to cool is precipitated in a purer state; the sediment may be again washed with light oil and spirit, or anthracen purified as above described may be heated until it fuses, and be then allowed to cool slowly. When it is desired to still further purify the anthracen, it is sublimed in a closed retort.

Improvements in the manufacture of bleaching-powder and in apparatus employed therein. Charles Wigg, alkali manufacturer, Liverpool. May 12, 1873.—No. 1725. First. Hydrochloric acid from Messieurs Hargreaves and Robinson's direct-action-sulphate converting chambers, or hydrochloric acid from any other source, is passed with atmospheric air into a heated closed retort or chamber containing pieces of pumice-stone or refractory material. The product of the decomposition, which is chlorine, is passed into a chamber containing lime on shelves, or through a series of chambers fitted with agitators. Second. The closed retort or chamber above mentioned is fitted with inlet pipes for hydrochloric acid and air, and an outlet pipe for chlorine. The entering air, when at pressure, may draw in the hydrochloric acid by lateral induction. Third. A series of chambers containing lime are connected by passages, and each chamber is provided with an agitator to throw up the lime and bring it into intimate contact with the chlorine and gases.

Improvements in the manufacture of metallic alloys. Alexander Parkes, Gravelly Hill, near Birmingham. May 13, 1873.—No. 1736. This Provisional Specification describes producing an alloy by mixing a manganese ore with a copper ore (or with an oxide of nickel) and carbon. These materials are exposed in a powdered state to a moderate heat in a closed retort. When the charge has been allowed to cool, the metallic globules which are found diffused through the mass are separated and melted.

Improvements in the manufacture of magnesia. Robert Stirling Newall, Washington Chemical Works, Newcastle-on-Tyne. May 13, 1873.—No. 1741. My improvement consists in submitting the magnesia, deposited in the manner described in the Specification of the Patent of Hugh Lee Pattinson, dated September 24, 1841, or other magnesia either in a dry or partially dry state, to pressure in moulds, by which process it is rendered denser and tougher, and therefore more suitable for transport than magnesia of the usual kind.

NOTES AND QUERIES.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

4361. (To Mr. Lawes). Professor Way states that the sewage permanently improves the land, and that the good effects of it may be seen many years afterwards; but he says that the power of the earth to extract the manurial properties from sewage-water are limited. Do you agree with him in that?—Yes.

4362. So, that if you exceed that limit, all the sewage that you use above that limit is wasted?—Yes.

4363. Would it run away into the drains?—Yes.

4364. Would you see that it was being wasted, by the water that ran through the drains being discoloured?—We have carefully analysed a great deal of drainage-water, and we find that there is a large amount of sewage in the water that runs away, and that in the water from the field that slopes the most is contained the most sewage.

4365. If you put on a small dressing, would there be less of that matter in the liquid that runs away?—Proportionably so, no doubt.

4366. (To the same). It is matter in suspension that colours the sewage-water, is it not?—Yes, that is almost all retained in the soil.

4367. But if the water that runs away is coloured, does it not prove that it still retains some of that suspended matter?—Yes, no doubt.

4368. The chief manurial properties of sewage-water are in solution, are they not?—Yes.

4369. But if the water that runs away contains matter in suspension, it is still more certain to contain what is in solution?—No doubt.

4370. Then if you see the water in the drains is coloured, you may be sure it is carrying away a good deal of the manurial property of the sewage, and you may be sure that the limited power of the earth to extract those properties from the sewage has already been exceeded?—No doubt.

4472. (Mr. Lawes.) I cannot conceive that sewage is really adapted for producing anything but milk profitably; it is a very weak grass that it produces, containing an immense amount of water, much more than common grasses contain; but it seems to be admirably adapted for producing milk.

4641. (To Mr. Lawes.) You spoke, did you not, of the retention of the fertilising ingredients of the sewage by the constituent parts of the soil?—Yes.

4642. Did not Professor Way discover that property of the soil?—Yes.

4643. Did he not state that that was a power possessed only by clay soils and other fertile soils of that nature?—To a great extent.

4644. Did he not state in his evidence that a sandy soil had not that power?—Yes, he did.

4645. Then a sandy soil would not retain the fertilising ingredients of the soil to a great extent, but all the soluble matter would run through with the water; would that be so?—Not the whole, but a considerable amount of it would.

MEETINGS FOR THE WEEK.

Tuesday, 7.—Civil Engineers, 8.
Wednesday, 8.—Society of Arts, 8.
—— London Institution, 7.
Friday, 10.—Astronomical, 8.
—— Quekett Microscopical Club, 8.

⁂ Vol. XXVIII. of the Chemical News, containing a copious index is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxix. commenced on January 2nd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

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[*] The word "combustible" is found in the copy of the Abridgment delivered by the Applicant, but does not appear in the original Abridgment.

THE CHEMICAL NEWS.

VOL. XXIX. No. 750.

RESEARCHES ON THE ATOMIC WEIGHT OF THALLIUM.[*]

By WILLIAM CROOKES, F.R.S., &c.

(Concluded from p. 147).

RESULTS.

TEN results of the most trustworthy weighings (with $NO_3 = 61·889$) are[†]:—

Determination.	True weights *in vacuo.* Weight of thallium taken.	Weight of nitrate of thallium + glass.	Weight of glass.	Calculated atomic weight from these data.
	Grs.	Grs.	Grs.	Grs.
A.	497·972995	1121·851852	472·557319	203·666
B.	293·193507	1111·387014	729·082713	203·628
C.	288·562777	971·214142	594·949719	203·632
D.	324·963740	1142·569408	718·849078	203·649
[‡]E.	183·790232	1005·366796	766·133831	203·642
F.	190·842532	997·334615	748·491271	203·636
G.	195·544324	1022·176679	767·203451	203·639
H.	201·856345	1013·480135	750·332401	203·650
I.	295·683523	1153·947672	768·403621	203·644
K.	299·203036	1159·870052	769·734201	203·638

I wish it to be noted that I have made determinations with considerable weights of thallium. In ordinary analysis, chemists are satisfied to take 5 or 10 grains of the substance under investigation: here I have gone to the very highest weight that can be entrusted, with safety, to the balance. The lowest weight of thallium taken is 183·790232 grains, the heaviest 497·972995 grains, the remaining determinations varying between these limits. It is hardly necessary to say that the purpose has been to eliminate the error arising from manipulation with small quantities, and to produce such variety in the results as to render the chances of coincidence of very small value.

Let me now tabulate the results of the determination, with the view to ascertain severally their degree of approximation to the arithmetic mean:—

A.	203·666	+·024
B.	203·628	−·014
C.	203·632	−·010
D.	203·649	+·007
E.	203·642	·000
F.	203·636	−·006
G.	203·639	−·003
H.	203·650	+·008
I.	203·644	+·002
K.	203·638	−·004

The arithmetic mean of the ten observations is

$$a = \frac{2036·424}{10} = 203·642.$$

But does this average represent the truth? Or, rather, how nearly does it represent the truth?

According to the theory of probabilities, the "weight" of a may be determined by means of the formula

$$w = \frac{n^2}{2\Sigma e^2},$$

where n = the number of observations, and Σe^2 = the sum of the squares of the successive differences, obtained by subtracting *each* observation from the arithmetic mean of the *whole*.

The arithmetic mean of the ten weighings is $a = 203·642$.

The sum of the squares of the ten differences between and each individual observation is—

e.	e^2.
+·024	·000576
+·008	·000064
+·007	·000049
+·002	·000004
·000	·000000
−·003	·000009
−·004	·000016
−·006	·000036
−·010	·000100
−·014	·000196

$$\Sigma e^2 = ·001050$$

Hence the weight of a is

$$w = \frac{(\text{number of observations})^2}{2\Sigma e^2}$$

$$= \frac{100}{·0021}$$

$$= 47619.$$

The largeness of this figure indicates the high degree of probability that a is very near to the true value sought. But the question, What is the true value? does not admit of absolute answer; for one of the observations was as low as 203·628, and one as high as 203·666. The number of possible values between 203·628 and 203·666 is infinite, the arithmetic mean a being but one of these values; and although more likely than any other that could be *named*, it is not more likely than *one or other* of all the possible values. The odds are many to one that a is *not* the truth; but they are also many to one that a is very near the truth. The question "How near?" cannot be answered; alter the question to "What is the probability that the truth is comprised within the limits $a \pm k$?" and the answer may be easily given, *however small k may be.* Thus if $k = ·01$,—in other words, if the question be "What is the degree of likelihood that the truth lies between 203·632 and 203·652?"—the answer is given by the formulæ

$$\left.\begin{array}{l} \pi = H, \\ t = k\sqrt{w}, \end{array}\right\}$$

having recourse to tables calculated from the celebrated Definite Integral,

$$Ht = \frac{2}{\sqrt{\pi}} \cdot \int_0^t e^{-t} . dx.$$

Let—

$$k = ·01,$$

$$w = 47619,$$

$$\sqrt{w} = 218,$$

$$\therefore\ t = k\sqrt{w} = 2·18,$$

$$\therefore\ \pi = H_{2·17} = ·99795.$$

(See Table I., at end of Professor De Morgan's "Essay on Probabilities.")

The result, = ·99795, is so near to unity, the measure of *certainty*, that for every practical purpose it may be considered *certain* that the truth is really comprised within the limits named.

By Table II. in Professor De Morgan's Essay, we can test the correctness of the preceding deductions; for—

$$\frac{62}{130\sqrt{w}} = \text{the probable error,}$$

$$\frac{k}{\text{probable error}} = t.$$

Then K, answering to t in Table II., is the probability required.

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[*] A Paper read before the Royal Society June 20, 1872.

[†] It should be noted that the arithmetic mean of *all* the readings, including the highest as well as the lowest result, in which doubt might arise as to success in manipulation, is 203·6.

[‡] Fully illustrated in the preceding text.

Hence— where $w=47619$,

„ $\sqrt{w}=218$,

$$\frac{62}{130\sqrt{w}}=\cdot0022,$$

$$\frac{k}{\cdot0022}=\frac{\cdot01}{\cdot0022}=4\cdot6=t,$$

to which corresponds in Table II. K=99808, against 99795, as before.

I may therefore conclude that, within the limits of error (as small as possible) of observation, the

ATOMIC WEIGHT OF THALLIUM = 203·642.

Professor Stas has shown the hypothesis of Prout—that the atomic weights of the elements are severally multiples of the atomic weight of hydrogen—to be without the corroboration of experimental result. This view of the hypothesis is further borne out in the present investigation; for the number 203·642 cannot, within the limit of what has been shown to be the probable error, by any liberty be made to follow the hypothesis. Without doubt, when the atomic weights of all the metals are re-determined according to the standard of recent scientific method, it will be found that there are more exceptions to the hypothesis than are commonly considered. Marignac gives, in his confirmatory discussion of Stas's experiments, and in his own results with calcium (40·21), lanthanum (94·13), strontium (87·25), analogous opposed evidence, as in the case of the weight found for thallium.

In the preceding pages I have given the method by which I have arrived at the atomic weight of thallium, whilst I have endeavoured to show that experimental chemistry is strictly a science of precision. Accordingly, the determination of the atomic weights of other of the elements (gold, chromium, platinum, rhodium, ruthenium, palladium, iridium, lithium, glucinum, cerium, and boron) is not a matter of supererogatory labour undertaken for the sake of verification merely, but is necessary to the progress of chemistry immediately as a science and technologically. For, until these elements shall have assigned to them more accurately their combining numbers, it will not be safe to enter into theoretical speculations respecting the interrelations between elementary bodies, nor possible to estimate them quantitatively without some error, which, small as it may be, yet remains an inaccuracy inadmissible to true science. One of the sources of error (that of neglecting the variation of atmospheric pressure during the weighings), it will have been seen, frequently introduces as much defect from the truth as impurity of the chemicals employed—a fact that has hitherto been greatly overlooked. Undoubtedly, larger errors are sometimes admitted to general chemical manipulation from deficiency or excess in the weights employed than would obtain from the use of materials of ordinary purity, although in the latter case to notice effects of variable pressure, or the loss by weight of air displaced, would be labour wasted.

Bearing these teachings of experience in my mind, I have striven to eliminate all erroneous influence in the number I submit to the Royal Society as the atomic weight of thallium; and I shall be amply rewarded for my long labour if I can know that the determination has secured to researches of this character a nearer approach to the standard of truth.

New Method of Obtaining Potassium.—Sergius Kern writes:—If sulphide of potassium be placed in a cast-iron retort with iron-filings, vapours of potassium and ferrous sulphide are obtained, according to the following equation:—$K_2S+Fe=FeS+K_2$. The potassium by the above process is far cleaner than that obtained by the reduction of potash with carbon; besides this, the formation of the black explosive substance (compound of carbonic oxide with potassium) is avoided.

ON THE
METHODS IN USE FOR DETERMINING THE VALUE OF VEGETABLE AND ANIMAL OILS.*

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland

(Continued from page 150).

We now proceed to an attempt to classify oils on the principles indicated in the earlier portions of the paper.

Class I. contains only one member, sperm oil, which for a long series of years has held the position of the dearest oil in the market.

Its commercial value is dependent upon the fact that only about 3000 tons are imported annually into this country, and secondly upon the fact that for a particular class of work, viz., the greasing of spindles of cotton, woollen, or worsted mills, it has been found to answer better than any other vegetable or animal oil.

The reasons which appear to establish the efficacy of sperm oil for this particular work are the small viscosity of the oil, combined with its freedom from all tendency to gum or dry on the machinery.

A cotton spindle is sometimes scarcely larger than a big penholder; and when there are, say, in one mill 40,000 or 50,000 revolving at the rate of from 2000 to 10,000 revolutions per minute, it is obvious that the great viscosity of other fatty oils would offer a resistance to motion of no mean character. Accordingly, we find oils which would suit an engine or big shafting, when applied to the bearings of a spindle, necessitates the employment of much more power, and, as a necessary consequence, the consumption of more coals than is required when sperm oil is used. The quantity of sperm oil coming into this country is far too small to supply even a fraction of the spinning mills of the United Kingdom. Even twenty years ago the scarcity was felt, the price reaching 20s. per gallon.

The great substitute for sperm oil in our days for this special purpose is mineral oil, which, by suitable combination with other oils, produces a product of the small viscosity or limpidity characteristic of true sperm oil, so that now we find most spinning mills using such preparations. From its scarcity, then, and high price, sperm oil is liable to adulterations.

Now the oils known to be lighter than sperm oil in specific gravity are mineral oil and an oil which comes in small quantity into this country under the name of African fish oil; whilst, on the other hand, the oils known to be heavier than sperm oil are all the other fifty or sixty oils known in commerce, most of them fully 30° or 40° heavier in specific gravity. Sperm oil is peculiarly light in specific gravity; it is stated in chemical books to be 0·875. The three refiners of sperm oil—Millars, Langton and Bicknell, and Messrs. Walls, of Glasgow—are supposed to be reliable, and I have found samples of guaranteed genuine oil from them stand about 0·882 or 0·883, or thereabouts; whether it should be lighter is difficult to say, as it is asserted that the young fish give a different gravity of oil to the old ones, so that we are reduced to the necessity of taking the best commercial oil as a standard. It is clear it should not exceed 0·882.

The specific gravity being correct does not necessarily imply the genuineness of the oil, because the specific gravity could be adjusted by mixing African fish oil or mineral oil with some of the heavier oils. In examining sperm oil it is necessary, therefore, to note the following points:—

(1). To examine for mineral oil.

(2). To examine into the drying properties of the oil, which is best done by exposing some of the oil in a thin layer to 200° F. for some hours.

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* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

(3). That the other fish oils darken much more notably than sperm oil when shaken up with dilute sulphuric acid.

(4). That the most likely adulterant is African fish oil, which produces intense heat when mixed with concentrated sulphuric acid; thus a mixture of 1 part of acid and 4 parts of oil develop about 112° of heat, against a development of heat of upwards of 250° with the African fish oil. The sp. gr. of this African fish oil is said to be about 0·866, and it is a very bad lubricant. (Other adulterating oils may also be detected by this test.)

(5). That, as the use of sperm oil is dependent upon its viscosity, an accurate test thereof in a suspected sample may be useful.

Class II. come next in valuo to sperm oil, viz., the oleins obtained by hydraulic or other pressure from animal fats, and known in the market as tallow olein, lard olein, and neats'-foot oil.

These oils have their market value established by the fact that, whilst being of heavy viscosity, they are practically free from tendency to gumming or clogging by the absorption of atmospheric oxygen.

In consequence, they are adapted for wool greasing and machinery of a heavy character. They are, however, generally too dear for wool greasing, and their use is almost confined to machinery purposes.

Now, with respect to neats'-foot oil, its importance is very much exaggerated in chemical books. It is only produced in very insignificant quantity, and from its strong smell, and its dark odour and high specific gravity, it is, of all other oils, the most unsatisfactory to examine and report upon; and there is much reason to believe that the name neats'-foot oil is used merely as a cover for mixtures of very inferior oils, flavoured up with a small dash of fish oils. Practically, the grease from which neats'-foot oil is produced is generally passed on to the soap-boiler; further, it must be observed that what is really valuable in neats'-foot oil is the olein expressed from it, which forms only a portion of the oil of commerce.

It is, however, otherwise with tallow and lard oleins, especially the latter, which is of very great commercial importance, and quite equal to neats'-foot oil in utility.

In examining these oils we have—first, variations in quality produced by carelessness in manufacture, viz., the oil being dark coloured (for both should be nearly white) or having too much smell (for both, and especially lard oil, should be nearly odourless), or else they may have an acid reaction owing to slight rancidity; this applies more particularly to tallow oil.

The variations in quality produced by adulteration will be in the direction of the non-drying properties of the oil being interfered with.

The first step in examining either lard or tallow oil is the specific gravity, which in both cases should be 0·915. If the oil is heavier it may contain fish oils, seed oils, olive oils, or cocoa-nut olein. Olive oil, cocoa-nut oil, or fish oils can be detected by the smell, colour, taste, and Calvert's tests, so that the real difficulty lies with seed oils, one of which, rape oil, is nearly of the colour, and exactly of the specific gravity, of animal oleins.

It will be found that if a sample of animal olein be *too heavy* in specific gravity it will probably contain some of the partially drying oils, of which the chief representative is cotton-seed oil, ranging in specific gravity between 920 and 930. The Americans, indeed, who send over immense quantities of lard oil, actually do adulterate with cotton-seed oil to a large extent, and one can almost calculate the percentage in the one by the increase of specific gravity, and the same remark applies to adulteration with other seed oils. Those seed oils which cannot be detected by variations in the specific gravity are rape oil, henbane seed oil, horse-chestnut oil, and plum-kernel oil. The three last may probably be disregarded, so that the chief point is the detection of rape oil, for which these processes may be indicated.

(1). Heating the oil to 400° F., and allowing it to cool to 90°. Tallow and lard oils are rendered odourless, whilst the peculiar penetrating smell of rape oil is developed.

(2). One part by weight of the oil to be tested is mixed with three parts by weight of concentrated sulphuric acid, and the heat developed is compared with that developed by a similar experiment made with pure oil.

(3). The nitrate of mercury test is said to indicate the presence of even 10 per cent.

Finally, lard oil is distinguished from tallow olein by difference of viscosity.

Inferior descriptions of tallow oil only fit for soap making are often quoted in the market.

(To be continued.)

INDIRECT DETERMINATION OF POTASH AND SODA.

By F. MAXWELL-LYTE, M.A., F.C.S.

I am not aware that the following mode of indirect determination of the alkalies potash or soda, when they are in the state of neutral sulphates, or can be brought to this condition, has yet been published under the present form.

As it is convenient, rapid, and fairly exact, I venture to give it you. Among other applications it will be found very convenient in the examination of sugar ash, but is useful in a variety of cases.

Having obtained the mixed sulphates free from any other salts, and in solution, I evaporate the mixture to dryness, heat to redness and weigh. I now re-dissolve the salts and estimate the *percentage* of SO_3 they contain by any convenient volumetric or gravimetric method, and from the percentage thus found I subtract the *percentage* of SO_3 the salt would contain were it pure sulphate of potassa. I adopt the figures 45·977 as a sufficiently close approximation to this last-named percentage, and by simply multiplying the remainder by 9·66, the result will be the percentage of sulphate of soda the mixed salts contained.

This result is not absolutely correct, for the multiplier is a little too high, but the error is not 1-10,000th, which is near enough for all intents and purposes.

The result obtained deducted from 100, the remainder will be the percentage of sulphate of potash, and from these results the quantities of each of the alkalies sought may be calculated. I prefer in the present case using the old atomic weights, as they admit of a nearer approximation to truth, with a multiplier of only 2 places of decimals, as given above.

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Paris.

FRIGORIFIC EFFECTS FROM CAPILLARITY COMBINED WITH EVAPORATION.*

By M. DECHARME.

A band of porous paper 10 or 12 centimetres long, 2 or 3 broad, folded two or three times lengthwise, or rolled up, is placed with one of its ends in a vessel containing sulphide of carbon. The liquid rises at first rapidly; in less than a minute it reaches a height of 7 to 8 centimetres. Then there appears at the upper part of the paper a uniform white zone of hoar frost, proceeding either from the condensation of the vapour in atmospheric air, or from the formation of a hydrate of sulphide of carbon. The layer gradually increases, and thickens and descends to about 2 centimetres above the surface of the liquid in the vessel; then the ascent of the liquid appears to be quite stopped.

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* Abstract of a recent paper to the French Academy.

Still, if the liquid does not pass the zone of hoar frost, the capillary aspiration continues none the less active in this zone itself, where one may soon see arborescences growing out perpendicular to the surface of the paper. These arborescences reach in half an hour 12 to 15 millimetres length in certain cases. Grouped together they present the aspect in miniature of masses of trees covered with hoar frost, or of fungi, or of heads of cauliflower. The phenomenon may continue indefinitely, provided one adds liquid from time to time to replace that which is volatilised. The arborescences begin to melt only some minutes after the sulphide of carbon has been completely exhausted.

Their formation is little retarded in full sunlight at a temperature of 35°. Further, when the liquid is heated in a water-bath with water at 60°, the phenomenon of hoar frost also appears, while the sulphide of carbon is in ebullition. The arborescences, though more rare and slender, are often longer than when produced in cold.

To estimate the lowering of temperature produced, the bulb of a small thermometer is wrapped in porous paper, and the instrument is so placed that the lower part of the paper is immersed in sulphide of carbon, the bulb being about 3 centimetres from the liquid surface. The layer of hoar frost is formed, and thickens, and the mercury descends in a few minutes from +20 to −15°.

It is even sufficient to plunge the thermometer, wrapped in its band of paper, into the liquid, and immediately to withdraw it, in order to the white layer appearing; and in less than two minutes the mercury descends from +20 to −12°, sometimes to −16°, if one agitates the instrument in air. It is to be remarked that in the liquid left to spontaneous evaporation, the thermometer with porous paper only falls to +5°, the temperature of the surrounding air being 15° or 18°.

A band of porous paper being simply immersed in sulphide of carbon, then immediately withdrawn, the zone of hoar frost in 20 or 30 seconds is seen to form, to increase during about a minute, then to melt. We have here a means of ascertaining at once, even in sunlight, the presence of aqueous vapour in atmospheric air. In foggy weather the phenomenon is more rapid, the deposit more abundant, and the cold more intense: thus we have a hygroscope of great simplicity.

It is easy to pass from the foregoing experiments to that of congelation of water; we have merely to wrap in a band of porous paper a small tube of thin glass, containing 2 or 3 centimetres of water, immerse it in sulphide of carbon, and draw it out immediately. The freezing of the water takes place in 2 minutes, ; when the air is dry, a second immersion is sometimes necessary.

If one makes the experiment with a tube 1 centimetre or more in diameter, the capillary aspiration and the evaporation have to be continued a longer time; with this view, the paper is so arranged that the maximum of cold is produced about the middle of the column of water, and it is plunged 1 centimetre in the liquid. One obtains in 15 minutes or half an hour (the column of water not being over 5 centimetres length) a beautiful cylinder of ice, the thickness of one's finger. If the evaporating process is stimulated by ventilation, or with the air-pump, the effects are still more rapid and intense. I am at present seeking for some convenient method of condensing the vapour of sulphide of carbon and rendering the operation practical.

Chloroform also produces phenomena of arborescence in porous paper, but less readily than sulphide of carbon. Sulphuric ether, though very volatile, does not produce them.

When one examines with a small microscope (20 or 30 diameters) the tops of the arborescence in process of development, one perceives in them a movement which does not at all resemble that of the crystallisations which are projected in the solar microscope. The thing looks like a moist paste in rapid fermentation; there are risings and sinkings, a kind of head will rise, then subside, then appear again, and with such rapidity sometimes, that the eye has difficulty in following the different phases. The phenomenon is only limited by the exhaustion of the liquid. It appears then that the arborescences are not of crystalline character, although there is a certain similarity in their structure. After exhaustion of the liquid, the terminal branch shows small crystalline points, which are, however, opaque, and as if efflorescent.

It is possible to project the arborescences by means of M. Duboscq's new apparatus with inclined mirror, which magnifies sufficiently for the effect. This makes a very good lecture experiment.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 2nd, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the previous ordinary meeting and of the anniversary meeting having been read and confirmed, and the donations to the library of the Society announced, the following names were read for the first time:—Messrs. John McLachlan Glassford, George Jarmain, William Bettel, Arthur Brotherton Allen, and Maurice Lichtenstein.

For the third time—Messrs. H. Critchett Bartlett, A. J. Greenaway, William Cunningham, George Henry Beckett, George Smith, and Capt. Mackay Heriot, who were balloted for and duly elected.

The first paper, "*On Sulphocyanide of Ammonium and Sulphocyanogen*," by Dr. T. L. Phipson, was read by the Secretary. After referring to a paper on this subject read before the British Association, at Norwich, the author remarks that the ammonium sulphocyanate produces a very great degree of cold when dissolved in water, and, as might be expected, developes much heat on crystallising, so that when a large crystal is formed the smaller adjacent ones dissolve again; the alcoholic solution presents in a high degree the phenomenon of supersaturation. The concentrated aqueous solution of the sulphocyanate dissolves iodine, and, when diluted and heated, the brilliant yellow compound called sulpho-cyanogen is deposited, and the liquid becomes colourless. Bromine acts in a similar manner. With chlorine the action is very complicated; for although some sulpho-cyanogen is obtained, along with other products, in concentrated solutions, with weaker ones the sulphur is gradually oxidised to sulphuric acid. The amount of ammonium sulphocyanate in a solution may be very conveniently and accurately determined by acidulating with hydrochloric acid and precipitating with a mixture of equal equivalents of the sulphates of copper and iron. The precipitate, dried at 100°, has the composition $CuCNS$. The author recommends the sulpho-cyanogen as a pigment of extraordinary brilliancy, for it can be ground up with 90 parts of white, and even then, when mixed with oil, it requires more white to bring it to the colour of chrome-yellow. Sulpho-cyanogen which, when dried at 108°, has the composition CNS is soluble in sulphuric acid, and is re-precipitated by water. It is decomposed, with effervescence, by nitric acid. Sodium also acts on it with violence, producing sodium sulphocyanide and sulphide. The author concludes his paper with some theoretical remarks on the constitution of sulphocyanogen, ammonium sulphocyanate, and sulpho-urea.

The President, in thanking the author, said that no doubt the method of precipitating as copper salt would be found useful for determining the amount of ammonium sulphocyanate in the commercial sulphate.

Mr. Clowes said he could confirm the statement of Dr. Phipson as to the great depression of temperature produced during the solution of the ammonium sulphocyanide. In an experiment he had made he had observed a temperature of −8° C.

The next paper, a "*Note on a Reaction of Gallic Acid*," by Mr. H. R. **Procter**, was then read by the Secretary. The author finds that, on adding a solution of sodic or potassic arsenate to one of gallic acid, the liquid absorbs oxygen from the air, and assumes an intense green colour, which changes to purplish-red by the action of acids. The test is very delicate if care be taken to avoid excess of alkali in the arsenate, but the presence of pyrogallol seems to interfere with the reaction. Oxidising agents change the colour to brown, and reducing agents likewise destroy the colour. Sodium hyposulphite renders the green paler. The green colour is not removed from the aqueous solution by agitation with ether, benzene, or bisulphide of carbon.

The **President** having thanked the author in the name of the Society, Mr. W. **Noel Hartley** read a communication "*On the Cobalt Bromides and Iodides.*" Metallic cobalt, placed in a dish with bromine and a little water, and allowed to stand for a week or so, dissolves, forming a purple solution, which on concentration becomes blue. If allowed to stand over sulphuric acid, it now deposits purple-red prismatic crystals, having the composition $CoBr_2.6H_2O$. Heated to 100° it fuses, loses water, and on cooling a mass of purplish-blue crystals are obtained, of the formula $CoBr_2.2H_2O$. At 130° it becomes an amorphous brilliant green-coloured mass, which is the anhydrous bromide $CoBr_2$. The iodide is prepared in a similar manner to the bromide, and on evaporating the solution, and allowing it to stand, a compact mass of green crystals. having the composition $CoI_2.2H_2O$, is formed. This salt is exceedingly deliquescent, absorbing water even more readily than calcium chloride. When dried at 100° it continuously loses weight, a portion of the iodine in the salt being replaced by oxygen. On evaporating a solution of cobalt iodide until it becomes green, and cooling it to 16° C., it assumes a brown colour: this, on standing a day or two, deposits large hexagonal prisms, of the colour of smoky quartz, having the formula $CoI_2.6H_2O$. When dried at 130° C. it leaves anhydrous cobalt iodide, CoI_2, which is black and lustrous like graphite.

Dr. **Odling** said they were much obliged to Mr. Hartley for his interesting paper, which illustrated so admirably the explanation that the variation in the colours of the cobalt salts is due to the difference in their hydration.

In reply to a question from the President, the author said that he had never spectroscopically examined the colourless solution obtained on mixing a green solution of a nickel salt with a pink cobalt solution.

Mr. **Clowes** stated that a dilute solution of cobalt chloride, which did not change colour when heated to 100° C., became blue on exposure to a comparatively high temperature in a sealed tube.

Mr. E. **Neison** then read a paper on "*The Distillation of Sodium Ricinoleate.*" According to Bouis, when sodium ricinoleate is distilled, it yields methyl-ethyl-keton, whilst Städeler says it gives nothing but heptylic aldehyd. Castor oil was therefore saponified by an excess of sodium hydrate, and the resulting soap salted out. This, when strongly heated in a copper flask, yields a liquid distilling entirely between 172° and 176°; in fact, 85 per cent came over between 172° and 173°, and was recognised as pure methyl-ethyl-keton. A castor-oil soap, prepared with a much smaller quantity of alkali, when distilled gave a brownish oil, of which but little more than 50 per cent came over below 200° C., the remainder consisting of neutral oils and fatty acids. The lower boiling-point portion, by fractionation, yields a large amount of heptylic aldehyd. From these results it would seem that the apparently contradictory statements of Bouis and Städeler are both correct, the difference arising from the nature of the soap used—one containing an excess, the other a deficiency, of alkali.

The **President** thanked the author for his paper in which he had so satisfactorily made out the conditions of the production of the compounds mentioned.

In reply to a question of Dr. Armstrong as to the manner in which he had made the estimation of the amount of the various products obtained, the author said that by careful fractional distillation in one case he had separated 85 per cent of the methyl-ethyl-keton boiling at 172° to 173°, and in the other more than half of heptylic aldehyd boiling between 153° and 156° C.

Mr. C. H. **Piesse** read a "*Note on the Solubility of Plumbic Chloride in Glycerin.*" He had made careful determinations of the solubility of plumbic chloride in pure glycerin, and in mixtures of glycerin and water, by agitating the finely divided chloride for a considerable time with the heated liquid, and then precipitating the dissolved lead as sulphate. The results show that pure glycerin dissolves 1·995 per cent of plumbic chloride; dilute glycerin, containing 50 per cent of water, 1·32 per cent; that containing 75 per cent of water dissolves 1·036 per cent of the chloride, and a solution containing 87·5 per cent water, 0·91 per cent.

In reply to a question of the President, the author said that plumbic sulphate was almost insoluble in dilute glycerin.

Mr. C. T. **Kingzett** read a communication "*On Ozone as a Concomitant of the Oxidation of the Essential Oils; Part I.*" It is generally stated in the text-books that the oxidation of oil of turpentine is accompanied by the production of ozone, although there has always been more or less doubt about its formation by this means. The author, after making numerous experiments on the variation of absorption of oxygen by different essential oils, and testing them with the potassium iodide starch mixture, fixed upon oil of turpentine as the most convenient for experiment. He found that the oil after exposure to air acquired the property of giving a blue colour to a solution of chromic and sulphuric acids, and of colouring potassium iodide starch mixture in a manner similar to ozone and hydrogen peroxide, but it produced no action on acetate of lead paper or sulphate of manganese paper. This property is not destroyed by washing the oil with water, even when air is excluded. Oil of turpentine was mixed with an equal bulk of water and partly distilled, both the aqueous and oily residue in the retort gave the colour reactions above mentioned, whereas the distillate did not, from which the author infers that they cannot be produced either by ozone or hydrogen peroxide, as these would be destroyed or removed during the distillation. Since it is destroyed when heated with zinc chloride even at 75° C., and also by sodium hydrate at 110°, he feels convinced that the substance producing the colour reaction is the monohydrated oxide of turpentine, $C_{10}H_{16}O.H_2O$. The author finds that many deoxidising agents likewise destroy it.

Dr. **Odling** said they were much obliged to Mr. Kingzett for his paper on a subject which had so much attracted the attention of chemists. Although evidence that ozone is formed during the oxidation of turpentine is altogether wanting, on the other hand he hardly thought the non-existence of peroxide of hydrogen was quite established, for it was a much more stable compound than is generally supposed. There were one or two points he would like to offer for his consideration. It had not been proved that hydrogen peroxide was more soluble in water than in turpentine, and therefore it was possible that it would not be washed out of the latter by water. Again, with respect to the treatment with zinc chloride destroying the property which the oil had of giving these colour tests, it was not known what the effects of zinc chloride might be on peroxide of hydrogen.

Mr. **Groves** asked the author as to whether he believed that the property which ether and the paraffins in petroleum acquired during slow oxidation of giving these colour tests, was due to the formation of a peroxide of ethyl or a peroxide of the paraffin.

The author said he was studying the action of zinc chloride, and hoped to treat of it in a second paper. With respect to the oxidation of ether, he had not investigated the subject himself, but understood that this property was connected principally with the air over the ether.

The last paper on the "*Action of Chloride of Benzyl on Camphor; Part II.*," by Dr. D. Tommasi, was read by the Secretary. By careful fractionation of the oils mentioned in the first part as obtained by the action of benzyl chloride on camphor, the author succeeded in isolating the following substances:—A liquid boiling between 151° and 152°, having a composition $C_{10}H_{14}$ or $C_{10}H_{16}$. In the former case it would be an isomeride of cymene, in the latter of terebene. Also a benzene derivative boiling at 176° to 178° C., and having the formula $C_7H_{10}O$: a compound boiling at 189° to 190°, of the composition, $C_{10}H_{14}O$, and therefore an isomeride of oxycymol and carvol, and, lastly, a liquid, $C_{16}H_{24}O$, boiling at 203° to 204°. The two last-mentioned bodies yield crystalline derivatives by the action of bromine. The substance, $C_{10}H_{14}O$, moreover, gives a nitro-compound heavier than water.

The President having thanked the author, adjourned the meeting until Thursday, 16th of April, when papers will be read "On some Isomeric Terpenes and their Derivatives (Part IV., Oil of Cajeput)," by Dr. C. R. A. Wright, and "On the Constitution of Urea," by Dr. D. Tommasi.

NOTICES OF BOOKS.

The Royal Commission on Scientific Instruction and the Advancement of Science.

The Commission has not been idle. It has just issued a fourth Report. The former reports treated mainly of Science teaching, and the conditions of Science instruction in schools throughout the country, while the present Report discusses National Scientific Museums and Collections. The Commissioners consist of—Two noblemen of considerable influence (both are in the House of Lords, and one of them is an elected trustee of the British Museum, and has been Chancellor of both the Universities of Cambridge and of London); also of two eminent physiologists, and two eminent mathematicians, one of whom is also a distinguished physicist; and, finally, of three well-known men of varied attainments,—all sincerely penetrated by a devotion to Science. When Dr. Miller was alive there was also a chemist among the Commissioners. The work has been well done. The Royal Commissions of the present age and parliament are not like those of fifty years ago.

The first part of the Report gives some interesting details concerning the administration of the British Museum, from which we learn that it is governed by no less than *fifty* trustees, twenty-five of which are *ex officio*. It has for some length of time been a question open to much difference of opinion whether personages such as the Archbishop of Canterbury, the Lord Chancellor, the Speaker of the House of Commons, and the First Lord of the Treasury, who have important duties to fulfil elsewhere, can adequately make appointments to the various offices in the Museum, and watch over its interests in every direction. The Commissioners do not give any opinion in regard to this broader and more general question, but they are of opinion "that the objections to the present system of government of the British Museum by a Board of Trustees, as at present constituted, so far as relates to the Natural-History collections, are well founded; and we have been unable to discover that the system is attended by any compensating advantages." The Commissioners accordingly suggest that a Director of the Natural-History collections should be appointed by the Crown, and that he should be entrusted with the entire control of the department. and be immediately responsible to a Minister of State. It has b eendecided to remove the Natural-History collections to South Kensington, and we believe a suitable building is now being erected for them.

In regard to the Hunterian Museum of the College of Surgeons (to the perfecting and maintenance of which the nation has contributed £57,500), it is suggested that no change be made, and that, if the necessity should ever arise, "it should receive support from the State, as an Institution intimately connected with the progress of Biological Science in this country." This is a very wise conclusion to have arrived at, for although portions of the collection would no doubt admirably supplement the British Museum zoological collections, the former, if removed from the College of Surgeons to South Kensington, would be far less accessible to medical students than they are at present.

The National Botanical Collections and Gardens at Kew are next discussed. The herbarium at Kew is remarkably good, while that at the British Museum is perhaps the finest in the world. It has been proposed to unite them, but the Commissioners do not adopt this view. The Kew herbarium was founded by Sir William Hooker, and at his death, in 1865, was purchased by the Government. For forty years it has received almost all the collections made by Government expeditions. The Gardens occupy 300 acres, and are believed to contain 20,000 *species* of plants. A number of gardeners are annually trained there, who are afterwards employed in some of our Colonies abroad. The principal recommendation made by the Commissioners in this regard is the following:—"That the collections at the British Museum be maintained and arranged with special reference to the geographical distribution of plants and to Palæontology; and that the collections at Kew be maintained and arranged with special reference to Systematic Botany."

We are glad to see that the Commissioners recommend the formation of a cabinet of physical and mechanical instruments, similar to that in the *Conservatoire des Arts et Metiers*. They further recommend the establishment of courses of lectures on scientific subjects, both in connection with the collection of apparatus and otherwise. This system has already been adopted to some extent. For several years lectures have been given at the School of Mines to working men, and long courses of lectures are now becoming general during the winter session in all our larger towns.

What we have now most to hope is that the valuable Report of the Science Commissioners will receive the earnest attention of both Houses of Parliament, and that the subject will be thoroughly discussed. A great step will be gained when the whole educational system—scientific and otherwise—of the country is placed under the control of a Minister of State, whom we would willingly call the "Minister of Public Instruction." We do not know whether by the late election we have lost any Members who were devoted to Science and to Education, and who would have led the discussion of the subject in the House, but we may at least console ourselves with the fact that many Members of the new Parliament are devoted to the educational interests of the country, and will no doubt bring forward the suggestions of the Commissioners and their own comments during this present Session.

Adulterations of Food, with Short Processes for their Detection. By R. J. Atcherley, Ph.D., F.C.S. London: Isbister and Co.

Dr. Atcherley is not free from "the last infirmity of noble minds." In the brief compass of 112—or rather 100—small and widely-printed pages, he undertakes to supply consumers and dealers with "easy and practical tests as to the purity of articles of food, and to give "processes of great accuracy, and requiring considerable experience in the manipulation," for the benefit of professional analysts. The methods described, we are told in the preface, are "the best in use at the present time," and all have been "found by the author to be trustworthy."

The plan of the work is simple: the various articles of food and drink are given in alphabetical order. Under each are mentioned the "probable adulterations," with their methods of detection, chemical or microscopical. Now, without at all questioning the value of the processes selected, we cannot help thinking that much of the information here given is superfluous for the chemist, and, on the other hand, altogether insufficient for the general reader. Thus, we have on page 2 instructions for the determination of sulphuric acid. The chemist does not need them, and the non-chemist will scarcely be able to perform the operation aright without more minute and detailed directions.

For the detection of picric acid in beer, the author gives a new test, distilling the "extract" with a solution of chloride of lime, when picric acid, if present, may be at once recognised by the peculiar and penetrating odour of the chloropicrin that passes over. We do not see that this process is superior to the old one of boiling in the suspected sample a little clean white woollen yarn, which, if picric acid be present, is dyed a fine pale yellow. Turning to the section on Bread, we are glad to find that the author does not recommend the "alum test." The observation that, if potatoes have been added, the aqueous extract of the bread will be neutral and the ash alkaline, is important.

The "probable adulterants" of butter form, according to the author, a long and revolting list:—"Water, salt, silicate of sodium, chloride of calcium, starch, potatoes, flour, cheese-stuff, rag-pulp, gelatine, beef and mutton suet, and various other fats." Of "rag-pulp," as an intentional adulteration, we never met with, nor heard of, an authenticated instance. Indeed, considering that salt and water can be incorporated with butter to the extent of 35 per cent, there seems little temptation for adulterators to try other sophistications. Under Ketchup, the author furnishes what must be regarded as full proof of its adulteration with the juice of putrefying livers of horses. For such frauds the existing Adulteration Act is far too lenient.

In speaking of cheese, the author quotes, from Normandy, a case of several persons poisoned by eating cheese coloured with anatto, which had been adulterated with red-lead. Such cases we consider to be very rare. Dyers and printers do not find anatto adulterated; and, on the other hand, it must be remarked that cheese perfectly free from any mineral impurity has sometimes been known to produce all the symptoms of an irritant poison. Dr. Atcherley omits, among the impurities of cheese, to mention potatoes and farina, which we have repeatedly found in Lincolnshire cream-cheese.

In cocoas and chocolates, it is open to question how far sugar is to be considered as an adulteration. In treating of milk, we regret to find the author still attaching a certain value to the indications of the lactometer. As Mr. Wanklyn has clearly shown in his recent work on "Milk Analysis," the fraudulent dealer, by removing cream, raises the specific gravity of his milk, and, by adding water, lowers it again to its former standard. In his instructions for the determination of the casein and fat, the author recommends the addition of plaster-of-paris. Mr. Wanklyn, as our readers will doubtless remember, cautions the student against such an admixture.

The adulteration of raw sugars with such substances as sand, gypsum, chalk, &c., whatever may have been formerly the case, is now very rare. We know that chemists have in vain attempted to meet with such samples, even in the lowest districts of London.

Under Tea, the author mentions iron filings among the probable adulterants, a point recently disputed. Why, by the way, does not Government legalise the sale of sloe-leaves as an admixture in tea, the purchaser being informed thereof by label or otherwise? They approach quite as near to tea as chicory does to coffee. In speaking of the adulteration of wines, Mr. Atcherley gives, on the authority of Dr. Muter, the statement that unadulterated port wine will float for a time on the surface of water, whilst, if elder-juice or brandy has been added, it sinks at once to the bottom. That elder-juice may have an "alacrity in sinking" we can well believe, but we should require high authority before admitting that the addition of brandy, a liquid specifically lighter, caused wine to sink in water.

The last twelve pages are devoted to the preparation of standard solutions, and there are also figures showing the microscopic characters of starches, coffee, cocoa, &c.

The Whole History and Mystery of Beet-Root and Beet-Root Sugar. By E. Lefroy Cull, of the Canada Company, Toronto. Toronto: Globe Printing Company.

The author of this pamphlet wishes to introduce the cultivation of the beet-root and the manufacture of beet-root sugar into Canada. He maintains that the roots grown in Canada are as rich in saccharine matter as the best French or German samples, and he gives very plain directions as to the method of extracting the sugar, and refining it, so far as to fit it for home consumption, and for the use of the professed refiner.

There is, however, one passage which requires a word of comment, and of warning for the public:—

"In all the departments in France and in Germany where beet-sugar is grown and manufactured, the yield of wheat produced by those departments has been more than doubled, and that notwithstanding that potash and soda is made from the refuse of the sugar and sold and taken away from the land, thus really depriving the land of important mineral constituents,—so fertilising to the farms is found the feeding of the beet-root pulp, and the increase of manure from the numbers of cattle kept on it, in spite of the loss of potash and salts in the sugar-crop."

Unless the supply of potash in a soil is unlimited, or can be created by the beet-root, or by the cattle fed on the pulp,—three utterly absurd suppositions,—the loss of potash must be supplied by some specific manure, or the land must sooner or later be reduced to complete sterility. In Germany the loss of potash is very generally compensated by the use of Stassfurt salts. We should strongly advise the Canadians not to sell the potash away from the land without some mineral is accessible which may supply the deficiency. If this last precaution is attended to, we quite agree with Mr. Cull that the cultivation of beet-root will improve the condition of the soil, and prove a valuable feature in Canadian agriculture.

Introduction to the Study of Organic Chemistry. By Henry E. Armstrong. London: Longmans, Green, and Co.

This work,—one of Messrs. Longmans' well known series of "Text-books of Science,"—is in its aim not descriptive, but systematic. The author confines his attention to compounds whose constitution and mutual relations have been determined, and leaves the reader to look elsewhere for information on bodies less thoroughly known.

After instructions on determining the ultimate constituents of organic compounds, the author enters upon formulæ. Whilst regarding "graphic" formulæ as a "more developed form of rational formulæ," he is sparing in their introduction. He gives indeed this most valuable and necessary caution!—"The use of these terms seems to imply, however, that such formulæ express the constitution or structure of the bodies to which they refer; but we must guard ourselves most carefully against this impression, since, hypothesis aside, we possess no real knowledge as to the internal constitution of chemical compounds, or of the mode of arrangement of the atoms of which bodies are presumed to be made up."

Such a caution coming from such a quarter is doubly valuable. We fear there are teachers of chemistry not a few who suffer their students to go away with the notion that "graphic" formulæ represent the actual relative positions of the atoms which make up a compound—a hypothesis which, to say the least, is far from proven. In the classification of the carbon compounds, the author does not adopt the common division into the two main groups of fatty and aromatic substances. In so doing we believe he is justified by facts. Certainly every dichotomous classification should, *a priori*, be regarded with great suspicion.

The tables of the homologous and isomeric substances of the different series are an interesting feature of this work and are likely to prove very useful to students.

CORRESPONDENCE.

SPECIFIC GRAVITY BOTTLE FOR SPONTANEOUSLY INFLAMMABLE LIQUIDS.

To the Editor of the Chemical News.

Sir,—In the March number of the *Journal of the Chemical Society* Mr. J. B. Hannay has made some observations *intended* to refer to the modification of Regnault's specific gravity bottle, suggested by me to meet the requirements of spontaneously inflammable liquids.

"The sole object," remarks Mr. Hannay, "of the modification is to allow of the liquids being poured quickly into the bulb." This passage alone exhibits, on the part of the writer, a complete want of knowledge of the contents of my note on the subject (see *Phil. Mag.*, October, 1873; Chemical News, vol. xxviii., p. 211). The fact is, the modification necessarily increases the difficulty of filling: hence the sentence in my paper—"A pipette with a capillary tube will be found convenient for introducing the liquid."

"When once the water-values have been determined for each division on the neck, it will be seen that it is only necessary to fill the bottle so that the surface of the liquid shall fall within the range of the graduations. Another advantage is that the contents can be raised or lowered to the normal temperature, and the volume read off without addition or subtraction of liquid." The object of the modification being thus expressed in my paper, I can understand the general tenour of Mr. Hannay's observations only by assuming that he has not even seen that which he has succeeded so well in misrepresenting.

After annihilating my bottle, the warrior modestly continues—"The apparatus above described (*i.e.*, Mr. Hannay's), however, is admirably adapted for any of these liquids"—such as zinc ethyl. But Mr. Hannay makes no mention of having tried the experiment.—I am, &c.,

Alfred Tribe.

April 8th, 1874.

RE-VALUATION OF SALT-CAKE OR CRUDE SULPHATE OF SODA.

To the Editor of the Chemical News.

Sir,—The method usually adopted in Widnes (the great centre of salt-cake manufacture) is as follows:—

The free acid (H_2SO_4) is determined by standard sodic hydrate.

The undecomposed NaCl is determined by standard argentic nitrate.

Then ·75 per cent is allowed for silica and ferric oxide, and this allowance I find to be practically correct.

The difference is then called Na_2SO_4.

Some few chemists, after determining the NaCl and H_2SO_4 as above, titrate with standard $BaCl_2$, and deduct the free H_2SO_4 from the total so obtained, and calculate the difference into Na_2SO_4; but this is obviously no improvement, and takes a much longer time.—I am, &c.,

R. J. Tinniswood.

Radcliffe near Manchester,
March 30th, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 16, 1874.

Acid Waters Arising in the Volcanoes of the Cordilleras.—M. Boussingault.—The water is found acidified by sulphuric acid and hydrochloric acid, the origin of which the author traces.

Mechanical Equation which Corresponds to the Equation $\int\frac{dQ}{T}=0$.—M. Clausius.

Report on Memoir of M. Marey on the Point of Support of a Wing on the Air.—The Committee briefly review the course of M. Marey's researches approving (with slight reservation) the results given in a recent note, and speaking highly of the methods adopted for registering movements.

New Typographic Model Map of Mont Blanc.—M. Viollet Leduc.

Action of Fresh Water on Metallic Lead; Researches by the Electrolytic Method.—MM. Mayercon and Bergeret.—Sulphide of lime is soluble in fresh water, and in water saturated with sulphuretted hydrogen. The latter gas does not show lead in a liquor unless the metal is in certain quantity. Calcareous and gypseous river-water dissolves metallic lead. The Saint Etienne water contains lead, but in too small quantity to be hurtful.

Method of Determination of the Density of Vapours—M. Croullebois.—The ordinary methods are unsuitable for some volatile substances which take fire spontaneously on contact with air, or are easily decomposed by various influences, or whose maximum tensions of vapour are not known between limits of temperature where the compound is stable. An example is liquid phosphoretted hydrogen. In the author's method a glass vessel 1¼ litre capacity, with well calibrated tube 1·20 m. long and 0·02 diameter, is filled with mercury, and inverted over a deep vessel of mercury. A capsule containing the liquid to vapourise is passed in and broken against the wall of the tube, on which vapourisation occurs, and the depression of the mercury is noted. Suppose the tube raised to increase the capacity. If there remain an excess of liquid at the same temperature the height of the mercury column will be unchanged. If, on the contrary, the liquid be entirely vapourised the vapour will behave like a gas subject to Mariotte's law, and the height of the mercury column increase.

Movements of Chlorophyll in Selaginellas.—M. Prillieux.

Relations which may exist between Thermo-Electric Properties and Crystalline Form.—M. Friedel.—The author's results are somewhat in opposition to those of the late M. Rose.

Preservation of Wood by means of Sulphate of Copper.—MM. Boucherie.—M. Hatzfeld questions the preserving power of sulphate of copper, and prefers the acid tannate of protoxide of iron. M. Boucherie contests this view, and points out the necessity of using a pure sulphate of copper, as samples containing 5 or 6 per cent of sulphate of iron give unsatisfactory results.

Facts Relative to the History of the Yeast of Beer.—M. P. Schützenberger.—The sample examined contained 29 to 30 per cent of solid matter. If boiled and washed with hot water it left an insoluble residue of from 20 to 21·5 per cent. If stirred up in water and allowed to stand for twelve to fifteen hours at a temperature of 35° to 40° C., it gives up to boiling water 17 to 18 per cent of soluble matter; the insoluble residue, dried at 100° C., weighs 12·5 to 13 per cent. The extract contains a notable amount of phosphates; a gummy matter resembling arabin; leucin and tyrosin; carnin, xanthin, guanin, and hypoxanthin. Urea, uric acid, creatin, and creatinin were not detected. Inorit and inoric acid are still to be sought for.

Observations Relative to the Recent Communication of M. Gernez on the Efflorescence of the Two Hydrates Formed by Anhydrous Sulphate of Soda.—A controversial paper in reference to communications read (*Comptes Rendus*, Jan. 19 and 26, 1874).

The Anti-fermentescible and Antiseptic Properties of Solutions of Chloral Hydrate.—MM. Dujardin Beaumetz and Hirne.—The authors find that solutions of chloral hydrate prevent the decomposition of a number of albumenoid and other animal matters, such as albumen, meat, milk, urine, &c.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin
No. 2, February 9, 1874.

Fluctuations in the Chemical Action of the Solar Spectrum, and on an Apparatus for its Measurement.—Herman Vogel.—Along with the action of various absorbents the author wished to determine with accuracy the chemical influence of the solar spectrum upon pure bromide of silver. He found it, however, impossible to obtain identical results. The action passed sometimes into the violet and ultra-violet, and at other times far into the yellow and red. It was found by special experiments that this fluctuation was not due to a varying sensitiveness of the plates. Hence the cause of the fluctuations had to be sought in changes in the relative intensity of the colours themselves. It is known that when the sun is low, and its rays have to pass through a greater thickness of the atmosphere, the intensity of the violet end of the spectrum decreases more rapidly than that of the red. In the spectrum of the setting sun violet is often absent (Maclear). Bunsen and Roscoe observed that the chemical power of different rays is extinguished by the atmosphere in different degrees at different times of the day. Both these chemists, however, have devoted very few experiments to this subject, and have occupied themselves with the determination of the total chemical action of sunlight, without reference to the share of every single colour in such action. They observed the decrease of the total intensity of the sun's rays with the decreasing altitude of the sun, and with the rise of the barometer. Their photometer, not very sensitive for red, yellow, and green, scarcely admitted the observation of fluctuations in the chemical action of the red end of the spectrum. The bromide of silver plates show these variations very distinctly. All the observations were made with a cloudless sky, and considering the short space of time in which the phenomena were observed, it is not very probable that they were due to changes in the surface of the sun itself. A full description of an apparatus for registering these changes photographically is announced.

Sulpho-urea and Guanidin.—J. Volhardt.—The author has obtained guanidin from sulphocyanide of ammonium.

On Cyanamid.—J. Volhardt.—The author describes a new and productive method of obtaining cyanamid. He takes an aqueous solution of sulpho-urea, not quite saturated, and prepared in the cold, and treats it with yellow mercuric oxide carefully washed. The oxide, which must be previously stirred up into a paste with water, is added very slowly in small portions. An excess of mercury is carefully to be avoided.

Preliminary Communication on the Production of Constant Normal Flames.—V. Wartha.—This paper is unintelligible without the accompanying illustration.

Remarks on Opium Bases.—O. Hesse.—A preliminary communication with reference to Dr. Wright's paper (*Berichte*, vi., 1551).

Nitro-Compounds of Inosit.—H. Vohl.—The author finds, in contradiction to his former results, that not one but two nitro-compounds are obtained by the action of concentrated sulphuric and nitric acids upon anhydrous inosit, namely, $C_6H_6(NO_2)_6O_6$ and $C_6H_9(NO_2)_3O_6$.

Phosphorite from Estremadura.—B. Niederstadt.—This phosphorite is brought especially from Logrosan, and is met with in commerce in the shape of hard, stoney, tuberous-looking lumps, about the size of a man's fist, and of a yellowish red colour. Its small percentage of iron and alumina, which together do not reach 2 per cent, gives it a great advantage over the phosphorite of the Lahn, as it yields superphosphates which do not become "reduced" on keeping. The percentage of quartz and of carbonate of lime is a drawback. The superphosphate obtained is dry and granular. Subjoined is the analysis of a sample of this mineral, ex *Porto Packet*:—

Phosphate of lime (tricalcic)	25·052
Phosphate of magnesia	3·798
Carbonate of lime	8·066
Sulphate of lime	1·200
Ferric oxide	0·621
Alumina	0·165
Fluor calcium	1·520
Manganese	trace
Silica	25·720
Water	0·250
	99·242

Total phosphoric acid 28·850 per cent.

Analysis of a Mineral from Orawicza.—J. V. Janovsky.—

Silica	30·73
Alumina	22·24
Ferric oxide	0·41
Ferrous oxide	3·01
Lime	37·93
Magnesia	6·10
Loss on ignition	0·37
	100·79

The specific gravity is 3·01 (see vol. vi., heft 19).

Oxidation of Ortho-Toluilic Acid obtained from Liquid Synthetic Dimethyl-Benzol by means of Chromic Acid.—Paul Jannasch.—The result obtained was an unimportant quantity of paraphthalic acid, no isophthalic acid being formed.

Basicity and Constitution of Iodic Acid.—Julius Thomsen.—The author concludes, that the proportions of water being equal, 1 molecule of periodic acid and a double molecule of iodic acid occupy the same volume, and that iodic acid is bibasic, and is to be expressed by the formula $I_2O_6H_2$.

Theory of Fermentation.—M. Traube.—The author, in a treatise published 1858, ascribed the action of yeast and similar ferments to their affinity for oxygen. Proceeding on this hypothesis he suspected that inorganic bodies, capable of attracting oxygen, must have an action upon sugar resembling that of yeast. He finds that at 150° to 160° platinum black splits up sugar dissolved in water. Carbonic acid is given off, and a volatile body with an odour like that of acetic ether, and which on the addition of chloride of calcium is separated from the water as a light oil, and gives with iodine and potash the well-known iodoform reaction.

Action of Cyanate of Potassa upon Sarkosin.—E. Salkowski.

Moniteur Scientifique, du Dr. Quesneville,
January 1874.

Analysis of Potable Waters.—Dr. F. Fischer.—This paper is accompanied by illustrations. The author proposes to determine organic matter by means of permanganate and ammonia by evaporating 500 c.c. almost to dryness with a few drops of hydrochloric acid, and distilling the residue with an alcoholic solution of potassa. The distillate is received in 20 c.c. of a decinormal acid, the excess of acid determined with a decinormal potash solution.

Analysis and the Properties of Blood.—M. Fernand Papillon.—A lengthy paper not adapted for abstraction.

Madder and Artificial Alizarin.—A. Rieu.—The author in a letter to Dr. Quesneville complains that the madder growers of the south of France have undertaken no studies of the respective yield of colouring matter under the influence of different manures; no experiments on the yield of the fifty known varieties of madder; no attempts to improve the strain by selecting seed; no attempts at diminishing the long stay of the plant in the earth; and, in short, no movements calculated to reduce the cost of this precious material.

Polytechnisches Journal von Dr. E. M. Dingler,
Band 210, 1.

Quantitative Determination of Oxide of Iron by means of Hyposulphite of Soda.—J. M. Crafts.

Preparation of Oxalic Acid from Sawdust Bran, and Lignose.—W. Thorn.

Experimental Investigation on Explosives.—Roux and Sarrau.

Purification of Water, and on the Action of Spongy Iron upon Impure Water.—Gustav Bischof.

A New Reagent for Blood, and its use in Forensic Chemistry.—F. L. Sonnenschein.

Preparation of Condensed Milk.—Trommer.

Band 210, 2.

Determination of Oxygen in the Gases Escaping from Lead Chambers.—L. Vogt.

Application of the Refuse of Towns.—F. Fischer.

Report on Coignet's Process for Preparing Animal Matters Destined for the Manufacture of Chemical Manures.—Hervé Magnon.

Preservation of Meat for the Army.—Broxner.

Utilisation of the Sulphuretted Mass.—Moritz Vollmar.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of carbonates of soda and potash, and in apparatus employed therein. Alfred Evans Fletcher, chemist, Liverpool. May 16, 1873.—No. 1786. This consists (1) in passing sulphurous acid, steam, and atmospheric air through common salt to form sulphate of soda; (2) in passing carbonic acid through heated sulphate of soda to form sulphide of sodium and carbonic acid; and (3) in passing the carbonic acid and water or its vapour through the sulphide of sodium to convert it into carbonate of soda. The sulphide of hydrogen finally given off is burnt and again used as sulphurous acid in the first stage of the process. Instead of carbonic oxide, gases or vapours containing hydrogen and carbon or carbonaceous matter may be used. The advantages of this process are that the same sulphur is used over and over again, and that the only materials required are salt and fuel. The apparatus consists of a series of two or more converting chambers connected by passages. The chambers may be heated.

Improvements in preserving stone, wood, and other substances from decay. Robert Austin Plunkett, Warren Point, Down, Ireland. May 16, 1873.—No. 1789. The preserving material is a solution of alum, in the proportion of about 1 pound of alum to 1 gallon of water, applied in a heated state to the surface required to be preserved or protected.

A new or improved compound for the manufacture of lime-cement or plaster, capable also of being used as an artificial fuel. The Reverend Granville Hamilton Forbes, Rector of Broughton, Northamptonshire. May 19, 1873.—No. 1816. The novelty of my invention consists in the mixture of tar with the foul lime of gas-works. The mixture is burnt, and afterwards reduced to a fine powder. It is then capable of being used as a substitute for common quick-lime in building, or as a substitute for plaster-of-paris. As the compound can be burnt in an ordinary grate, it can be used with other fuel for domestic or other purposes.

Improvements in the manufacture of explosive compounds. Samuel Joseph Mackie, and Camille Alphonse Faure, both of No. 3, Delahay Street, Great George Street, Westminster. May 20, 1873.—No. 1830. This Provisional Specification describes means by which gun-cotton in a fibrous state as when made from cotton waste or skeins may be formed into granules or lumps. Granules formed from gun-cotton which has been reduced to an impalpable powder, and either alone or mixed with other materials, are rendered compact by causing a plunger to descend into a chamber containing a quantity of such granules, the surfaces of the granules having been previously powdered over to prevent their sticking together. The compressed cake of granules so produced is afterwards broken up—also an improved process of drying gun-cotton and other solid explosives—also mixing various substances with gun-cotton and such like.

A new or improved compound for the manufacture of cements or artificial stone, capable also of being used as an artificial fuel. The Reverend Granville Hamilton Forbes, Rector of Broughton, Northamptonshire. May 20, 1873.—No. 1832. The novelty of my invention consists in the mixture of chalk or limestone with the foul lime of gas-works and with tar for the purpose of making cements or artificial stone. The compound is also capable of being used as an artificial fuel which when sufficiently burnt leaves a valuable residue.

NOTES AND QUERIES.

Lakes.—Will some kind reader please answer the following:—After the precipitation of alumina and colouring matter, are any other ingredients added? Why and how are lakes made into cones, and at what temperature are the cones dried?—M. Houghton.

Carbonising Peat.—The *Scientific American* of March 26 contained an article concerning an invention of Mr. Kidd's for carbonising peat taken from your paper. I would like to get further particulars from parties interested in said apparatus, as to the efficiency, cost, and quality of the peat after treatment. I can control a large peat-bed, and if the peat after the treatment would be suitable for making gas, and to use in furnaces, &c., could find a market close by for same.—G. M. H.

Estimation of Nitrogen.—(Reply to "Student.")—By Dumas's method (combustion with oxide of copper) determine the total nitrogen; and by Varrentrapp and Will's (soda-lime) the nitrogen present as ammonia salts and organic matter: the difference is the nitrogen due to nitrates (details in "Fresenius.")—T.

Estimation of Nitrogen.—(Reply to "Student.")—Take 150 grs. of the sample containing nitrogenous organic matter, sulphate of ammonia, and nitrate of soda. Wash out the sulphate and nitrate with water, diluting the filtrate up to 10 m. grs. measure (leaving the nitrogenous organic matter upon the filter, which may be dried and converted into ammonia with soda-lime). For estimation of the ammonia in the sulphate, take 1 m. grs. measure of the filtrate, which represents 15 grs. of the original sample, introduce into a distilling-flask or retort, and drive off the ammonia with caustic soda (receiving it into normal acid, and estimating as usual). This leaves the nitrate of soda in an alkaline solution ready for converting into ammonia with zinc and iron, or aluminium, at the discretion of the analyst. I have adopted this method some years, and found it work well.—E. Hunter.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

4728. (To Professor Way.) You stated in your evidence before the Committee on the Sewage of Towns in 1862, that soils contain a power of separating from liquids containing manure all the important elements of the manure, and that the action takes place not by mere filtration, because those dissolved matters would pass through a filter, but by a sort of chemical attraction, between the ingredients of a fertile soil and those of manure?—Yes. At this moment there is a dispute as to what the nature of that action is. Baron Liebig believes that it is a physical action similar to the action of charcoals in removing colour from syrups and things of that kind; my own conviction is, that it is a true chemical action; but it is not at all a settled question.

4729. It is an attraction between the clay and the manurial property of the sewage, is it not?—Yes, in a great measure.

4732. The moment the sewage has sunk into a clay or loamy soil, does not the smell disappear?—Yes.

4733. Is that because those manurial properties have all been abstracted by means of the soil?—Yes.

4740. (To the same.) It is merely a filtration, is it not?—Not exactly a filtration, speaking of sand, apart from vegetation growing on the sand, sand has a peculiar power, which is totally different from the power clay possesses, of which we were speaking just now, but which is still a specific power of its own, absolutely separating salts up to a certain point, from solution. Very old observations have been made by Dr. Hall and other philosophers 200 or 300 years ago, in which the filtration of salt water, for instance, through pots of sand, was found would give water free from salt at all.

4748. Would lime be injurious?—No.

4752. Does lime neutralise those matters that are contained in solution in the sewage, or does it only precipitate those that are in suspension?—That is all, it acts like white of egg in clearing coffee.

4767. (To the same). There is a report which has been sent to this Committee from Paris, which was made by M. Béhic to the Emperor, that the amount of manure used in 223,000,000 tons, and is worth about £20,000,000 sterling: can you tell us the amount that is used in this kingdom; is it as much as that?—I have not seen that report; does that refer to artificial manures?

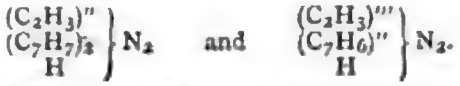
THE CHEMICAL NEWS.

Vol. XXIX. No. 751.

ON THE ACTION OF REDUCING AGENTS UPON BENZONITRANILIDE.[*]

By CHICHESTER A. BELL, M.B.

We know, from the experiments of Prof. Hofmann,[†] that by the action of phosphorus trichloride on the compounds of the aromatic monamines with formic and benzoic acids and their homologues, a series of diamines is produced, in which groupings of the form C_nH_{2n-1} or $C_{n+6}H_{2n+3}$ take the place of three atoms of hydrogen. Bodies of similar constitution, containing, however, diatomic in addition to triatomic groups, were subsequently obtained in this laboratory by Hobrecker,[‡] but in a totally different way, namely, by the reduction of the corresponding nitramides. Thus toluidin and glacial acetic acid with phosphorus trichloride yield ethenyl-ditoluyl-diamin, while the reduction of nitrotoluol-acetamide gives ethenyl-toluylen-diamin.

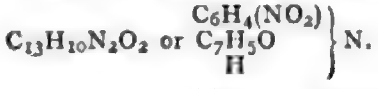


$$\left.\begin{array}{c}(C_2H_3)''\\(C_7H_7)_2\\H\end{array}\right\}N_2 \quad \text{and} \quad \left.\begin{array}{c}(C_2H_3)'''\\(C_7H_6)''\\H\end{array}\right\}N_2.$$

Hobrecker has experimented with acids of the fatty series only, and it remained to be seen whether similar diamines could be produced with benzoic acid and its homologues.

A few combinations of benzoic acid were already known, which might be employed for the solution of this question. A nitrophenyl-benzamide, of which, however, no description is given, had already been prepared by Engelhardt[‖] by heating nitraniline with benzoyl chloride; and by the action of nitrobenzoyl chloride on aniline, Cahours[§] had formed a phenylated nitrobenzamide. It was to be expected that by nitrifying benzanilid an isomer would be produced, and in fact this has been recently described by Hübner and Retschy.[¶]

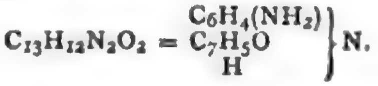
The following short notice refers to the compound first observed by Engelhardt. Nitraniline (obtained by reducing dinitrobenzol) was strongly attacked by benzoyl chloride, and from the resulting mixture of benzonitranilide and nitraniline hydrochlorate, the latter was extracted by boiling water, and the remaining amide crystallised, first from hot amyl-alcohol, and subsequently from boiling ethylic alcohol. Benzol and cold spirit dissolve it slightly. After repeated crystallisations, white transparent crystalline plates are obtained, which melt at 152° C.[**] By treating these with concentrated acids or alkalies, benzoic acid and nitraniline are reproduced. Analysis gave results corresponding to the formula—



$$C_{13}H_{10}N_2O_2 \text{ or } \left.\begin{array}{c}C_6H_4(NO_2)\\C_7H_5O\\H\end{array}\right\}N.$$

	Theory.	Analysis.
Carbon	64·46	64·40
Hydrogen ..	4·13	4·51

The reduction of the nitramide was accomplished by sulphide of ammonium in alcoholic solution. The purification of the resulting base is attended with difficulty, but is best effected by repeated crystallisation, first from boiling dilute alcohol, and subsequently from boiling water. In strong alcohol it is freely soluble. In appearance it is similar to the preceding compound, while its fusing-point is 125° C. Its composition corresponds to the formula—

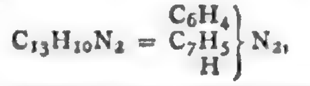


$$C_{13}H_{12}N_2O_2 = \left.\begin{array}{c}C_6H_4(NH_2)\\C_7H_5O\\H\end{array}\right\}N.$$

	Theory.	Analysis.
Carbon	73·58	73·81
Hydrogen ..	5·66	6·14

Thus the nitro-group had simply passed into the amido-group, the benzoyl-group remaining unaffected. Concentrated sulphuric acid reproduces from the combination benzoic acid, probably with simultaneous formation of a salt or a sulpho-acid of phenylen-diamin.

Want of time has prevented me trying whether other stronger reducing agents, such as tin and hydrochloric acid, could effect further reduction and reproduce the oxygen free base—



$$C_{13}H_{10}N_2 = \left.\begin{array}{c}C_6H_4\\C_7H_5\\H\end{array}\right\}N_2,$$

which Hübner and Retschy have obtained by the complete reduction of nitrobenzanilid.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,

Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 141.)

II. Tea.

Until recently, the methods of detecting the adulteration of tea were in a very unsatisfactory condition, but the subject has been very successfully studied during the past year, and there is now no important adulteration of tea which cannot be detected with proper care.

Tea is commonly divided into the two great classes, of green and black. It is now well proved that the difference in the colour is dependent on the method of preparation, and not on any difference in the nature of the plant. Thus the Darjeeling Tea Company are now preparing as green tea the leaves from the same plants of which they have hitherto manufactured black tea.

The soil on which the tea is grown, the climate, the time at which the leaves are gathered, and the details of the manufacture, all affect the *quality* of the tea, regarded as a commercial article, but they fortunately have but little effect on its composition. On this account, the analyses of genuine teas (when performed in the same way) show a remarkable constancy of composition, as will be seen by an inspection of the accompanying tables, and it would be impossible to tell uniformly from the analytical results which teas would command the highest price. This fact is of great importance, for, while any extensive adulteration is rendered apparent from the analysis, there is little danger of mistaking an inferior tea for an adulterated one.

The most valuable constituent of tea, from a dietetic point of view, is undoubtedly the alkaloid *theine*, and it is also the most variable, the amount present in genuine teas ranging from 1·9 to 5·8 per cent (Bell). On this account, its determination is valueless as a criterion of adulteration, though of primary importance when forming an opinion on the *quality* of a tea. No doubt tea-tasters are greatly guided by the amount of theine (ascertained by the taste), though the essential oil, bouquet, tannin, and colour of the infusion also furnish them with valuable information.

Of the commercial value of a tea, of course a tea-taster s the best judge, but the following facts clearly prove that he is not always competent to judge of the presence of certain adulterants, especially exhausted leaves, which merely tend to produce a general weakening of the tea without appreciably altering its bouquet, flavour, &c. Some teas give much darker infusions than others, so that adulteration cannot be recognised by this character alone.

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[*] From the University Laboratory, Berlin.

[†] Hofmann, *Monat Berichte der Berl. Akadem.*

[‡] Hobrecker, *Berichte der Deutschen Chem. Gesellschaft*, 1872, 920.

[‖] Engelhardt, *Petersb. Acad. Bull.*, xiii., 357, 379.

[§] Cahours, *Ann. Ch. et Phys.* [3], xxiii., 329.

[¶] Hübner and Retschy, *Ber. der Deutsch. Chem. Gesell.*, 1873, 798, 1128.

[**] In the notice recently published by Hübner and Retschy, the fusing-point of the isomeric nitrobenzanilide obtained by treating benzanilide with nitric acid has not been given.

I purchased a pound of black tea at 2s. 6d., and infused a portion of it, using fresh quantities of water, till scarcely any further colour was obtained. The exhausted leaves were re-dried, broken up, and mixed in various proportions with the original tea. The adulterated teas thus obtained were then taken to a professed tea-taster, who liquored them in my presence. He understood that some of the samples contained exhausted leaves, the presence of which was more or less disguised, but I told him that the tea was free from sandy or magnetic matter, foreign leaves, &c.

	Conclusion.
No. 1. Contained 30 per cent of exhausted leaves.	Tasted "washed out," no doubt from presence of exhausted leaves.
No. 2. Tea in original condition.	Genuine.
No. 3. Original tea, somewhat crushed.	Mixed with exhausted leaves !
No. 4. Contained 20 per cent exhausted leaves, a little Na_2CO_3 having been added during the re-drying.	Genuine ; better tea than No. 3 !
No. 5. Contained 20 per cent exhausted leaves, and a little catechu.	A washed-out tea, to which some astringent matter had been added.

Although Nos. 2 and 3 were exactly the same tea, the taster failed to recognise their identity by the taste, and actually classed an adulterated tea as superior in flavour to the broken genuine tea.

The adulterations of tea may be conveniently arranged under four heads—1. Mineral additions used for increasing weight or bulk. 2. Organic additions used for increasing weight or bulk. 3. Adulterants used for imparting fictitious strength. 4. Facings and colouring materials.

1. *Mineral Adulterations Used for Increasing Weight or Bulk.*

These are—Magnetic matters, such as magnetic iron ore, and lumps and filings of iron; and siliceous matter, as sand, fragments of quartz, &c.

Magnetic Matter is best detected by pounding a known weight of the tea (10 grms.), and placing it on a sheet of smooth paper. A magnet or electro-magnet is applied to the under-side of the paper, and moved laterally, with its poles in contact with the paper. Any magnetic matter is thus readily drawn out and separated from the tea; the use of the magnet should be continued till nothing more follows it. The magnetic matter is next boiled with water for a few minutes to detach adherent organic particles, and the water is then decanted. The residue is next weighed, and then examined under the microscope as an opaque object. If it consists of magnetic oxide or titanate of iron, crystalline facets will probably be apparent, the bulk of the object having a jet-black colour. Occasionally, though very rarely, metallic iron is present. This is distinguished from the minerals by the action of moderately concentrated nitric acid (1·2), which dissolves it, with production of red fumes, but does not affect the native compounds. Metallic iron is also distinguished by its power of precipitating metallic copper when warmed with an acidulated solution of cupric sulphate. The weighing of the matter actually extracted by a magnet is far more satisfactory than the estimation of the iron existing in the tea. Tea naturally contains a small proportion of iron as ferric phosphate, but it only amounts to about 3 per cent of the weight of the ash (calculated as Fe), or to about 0·18 per cent of the whole tea. Of course this is not affected by a magnet, the use of which has the additional advantage of extracting the extraneous iron in the state in which it naturally exists, and allows of its production in court for the enlightenment of sceptical magistrates.

Caper teas are very frequently adulterated with magnetic matter, sometimes to the extent of 7 or 8 per cent. Many tea-dealers habitually employ the magnet, the use of which is well known to the trade.

Siliceous Matter is readily detected and estimated. Commence by igniting 2 or 3 grms. of the tea in a platinum crucible till all organic matter is consumed, and then weighing the ash. The percentage of this at once indicates the presence or absence of extraneous siliceous matter, provided no magnetic matter is present. The ash of genuine tea varies from 5·24 to 6·00 per cent. Owing to the presence of steatite in the facing of some green teas (especially gunpowder), the ash of these sometimes reaches nearly 8 per cent.

For the estimation of the amount of extraneous silica, the ash should be well boiled with water, and the liquid filtered (the proportion of soluble ash being a valuable criterion of the presence of exhausted leaves). The residue is washed off the filter (or the paper ignited), and boiled with concentrated hydrochloric acid. The extraneous silica, consisting of quartzose particles and insoluble silicates, is left undissolved, and after collection on a filter, washing, and ignition, it may be weighed. The highest recorded amount of ash insoluble in hydrochloric acid occurring in a genuine unfaced tea is 0·82 per cent (Wilson), the average being about 0·30 per cent.

"Caper tea" is the kind most frequently adulterated with siliceous matter, the amount added sometimes reaching 15 or 20 per cent. Of nineteen Canton capers recently examined by Dr. Hassall, the sandy matter varied from 2·09 to 12·83 per cent. I have not met with so high an amount as the latter figure, but 8 and 10 per cent of this adulterant are common.

Frequently the silica exists in the form of quartz fragments of very sensible size. Tea-dealers are well aware of the existence of this adulteration, and of the class of teas most subject to it, and they know that, if present, they will see the sand, &c., at the bottom of the vessel in which the tea is infused.

If desired, the iron can be estimated in the hydrochloric acid solution of the ash by one of the volumetric methods.

2. *Organic Adulterations Used for Increasing Weight and Bulk.*

These are—Exhausted tea-leaves; and leaves other than those of the tea-plant. The chemical methods for the detection of these adulterants are much the same, but in the latter case we have also the botanical characters of the leaf to rely on, and these are sufficiently definite to enable us to form an opinion quite independently of the analytical results.

Exhausted Tea-Leaves are leaves which have been previously infused in water, and then re-dried, with or without addition of gum or starch.

It is evident that the effect of infusing tea-leaves in water is to extract the greater part of the soluble constituents of the tea, and that the re-dried leaves will have a widely different composition from the original tea.

The two principal constituents extracted from tea by hot water are tannin and gum,—more or less colouring matter, soluble salts, theine, &c., being also dissolved.

Tannin.—Of the soluble constituents, the tannin is by far the most important and constant, but unfortunately until recently the methods of estimating its amount were very unsatisfactory, the whole of the soluble extract, after allowing for the gum, having sometimes been called tannin. I believe I was the first to use a more satisfactory method of determining the tannin in tea, my process being essentially a precipitation by a standard solution of gelatin.[*] Although the method has since been employed by Hassall, Bell, and other chemists, I have recently been led to abandon it, on account of the tedious nature of the process, the trouble of daily re-setting the gelatin solution, and the occasional anomalous results, which defied all attempts to ascertain their cause.

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[*] Full details of this process will be found in the *Pharmaceutical Journal* for Oct. 25, 1873, and in the "Year-Book of Pharmacy," 1873

A very valuable method of estimating tannin has recently been described by Mr. Charles Estcourt,[*] who seems to have succeeded in determining the relative amount of tannic and gallic acids in tea. But while fully appreciating the scientific value of Mr. Estcourt's results, it seems to me that the separate determination of the tannic and gallic acids is a needless trouble and a complication of the methods of detecting tea adulteration. It also seems probable that a portion of the tannic acid may be converted into gallic acid by the prolonged boiling in water necessary for the thorough exhaustion of the tea, and on this account a method which will estimate the total amount of astringent matter, without distinction of its nature, is preferable to a process that gives merely the amount of tannin, while ignoring the gallic acid.

Black tea differs from green tea in the method of its manufacture, the leaves being allowed to undergo a kind of fermentation when black tea is to be produced. During this fermentation, a portion of the tannin becomes altered, with production of dark-coloured insoluble matters, so that black tea is found to contain a higher percentage of insoluble matter and a lower percentage of tannin than green tea, the sum of the two constituents being moderately constant. By the process of fermentation, the remaining tannin undergoes a curious change, for the tincture of green tea precipitates tincture of ferric chloride bluish-black, like nut-galls, while the tincture of black tea gives a green colour with iron, just as catechu does. If excess of ammonia be added to either coloured liquid, a soluble oxidation-product is formed of a deep red colour. Other oxidising agents may be substituted for the ferric chloride, potassium ferricyanide being the most convenient.

If a solution of tannin or an infusion of tea be treated with a strongly ammoniacal solution of potassium ferricyanide, a deep red liquid is obtained, the depth of colour being a fair indication of the amount of tannin present. This reaction is exceedingly delicate, $\frac{1}{100}$ milligrm. of tannin being recognisable by it. This is considerably beyond the range of delicacy of the dark colouration produced by iron salts.

When an infusion of tea is precipitated by gelatin in excess, the red colouration is still produced in the filtrate, so that the reaction cannot be used as a colour-test for the end of the precipitation by gelatin, but, if a solution of lead acetate be substituted for the gelatin, an insoluble precipitate of mixed tannate and gallate of lead is thrown down, and no colour is produced in the filtrate on addition of ammoniacal ferricyanide.

Upon these facts, my assistant, Mr. F. W. Fletcher, has founded a process for the estimation of the astringent matters (tannin, &c.) in tea, and we have used it with the greatest success during the past six months in the examination of upwards of a hundred specimens. The details of the process will follow, and I can confidently recommend it as a most rapid and satisfactory method deserving of general use. It is necessary to adhere to the proportions of fluid operated upon, and it must be borne in mind that tannate of lead is not insoluble in free acetic acid unless the solution is sufficiently diluted.

(To be continued).

VALUATION OF ANTHRACEN.

By T. H. DAVIS.

The methods at present in use for estimating the amount of anthracen in the crude material for commercial purposes must be ackowledged by all as being far from satisfactory. Of these methods the ones generally used are known as the "alcohol test," and the "bisulphide of carbon test." In the first of these 20 grammes of anthracen are heated to boiling with 150 c.c. of alcohol of specified strength, allowed to cool to 15° C. and then washed with alcohol of the same strength, until the washings together with the filtrate amount to a stated quantity, usually 400 c.c. The undissolved material is then dried at 100° C. removed from the paper and weighed, the result being multiplied by 5 to obtain the percentage. The melting-point of this undissolved portion is next taken, by heating a small quantity of it enclosed in a glass tube of narrow bore, and drawn out to a point at one end in a bath of sulphuric acid, noting the temperature at which it begins to melt, and also that at which it begins to solidify; the mean between these two readings is taken as the mean melting-point. Now in this method we find that alcohol dissolves a quantity of anthracen, and that it does not dissolve out the chrysen present, and although the weighing of this latter body may to a certain extent make up for the loss of anthracen dissolved by alcohol, yet the result obtained is incorrect as regards the estimation of pure anthracen.

The estimation by CS_2 is somewhat similar to the alcohol method. 10 grammes of crude anthracen are placed in a stoppered bottle, 30 c.c. of CS_2 are poured into it, and the contents well mixed by shaking; the whole must now be set aside at rest for about an hour, at the end of which time the contents of the bottle are poured on to a filter, and the funnel covered with a ground glass plate; 30 c.c. more of CS_2 are now measured and poured into the bottle for the purpose of washing it out, and then poured on the filter. When filtration has ceased the filter is pressed with the fingers, quickly transferred to a screw press, and pressed between blotting paper, so as to get out as far as possible all the CS_2 retained by it; it is then dried at 100°, removed from the paper and weighed, multiplying the result by 10 for percentage. The melting-point of the residue is taken in the same way as in the alcohol method.

This process is to my mind more objectionable than the former, for CS_2 dissolves something like 2 per cent of anthracen and owing to its volatility it is next to impossible for two chemists to prevent evaporation to the same extent, and they therefore disagree in their results. I have known two chemists differ in their results by as much as 4 to 6 per cent in the same sample. When this "bisulphide test" has been used, and in the alcohol method, discrepancies of 2 and 3 per cent frequently occur.

Now as anthracen is an expensive article, and being brought and sold by analysis, the most correct method should be employed, and one in which two or more chemists ought not to disagree more than 0·5 per cent. Such a test I believe to be the one in which anthracen is oxidised to anthrachinon, and weighed as such. For this purpose I take 1 gramme of the well mixed sample, and dissolve it in 40 to 50 cc. of glacial acetic acid, by boiling in a small flask for about 5 or 10 minutes, at the end of which time the liquid becomes quite clear, and of a yellow brown colour. A solution of 10 grms. chromic acid in jus sufficient glacial acetic acid and water to dissolve it should be made beforehand, and allowed to stand for a short time, so as to allow the lead present in the chomic acid to settle to the bottom. When quite clear, this solution is poured into the acetic acid solution of anthracen until the chromic acid is in excess, indicated by a drop of it leaving a red spot of chromate of silver when placed on a silver coin; if the flask is now examined a yellowish green precipitate will be found to have made its appearance. The whole should be put by, and when cool diluted with distilled water to about 200 cc.; it should then stand for 6 or 8 hours, when it is filtered through a previously weighed and moistened filter, washed with distilled water till the filtrate is clear, then once or twice with a hot weak solution of soda, and finally with distilled water again until the washings are neutral. The anthrachinon upon the filter should now have a fine yellow silky appearance; it must be dried at 100° C. and weighed till constant, and from this result the percentage of *pure anthracen* in the sample is the result of an easy calculation after adding 0·01, as directed by E. Lüc for anthrachinon dissolved.

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[*] Chemical News, vol. xxix., p. 109.

As an example I give the result of one estimation carefully made of a sample of crude anthracen, compared with the results by alcohol and bisulphide of carbon:—With alcohol 0·825 sp. gr. = 89 per cent, 34·645 per cent insoluble, and melting-point of 187·5° C. With CS_2, 23·250 per cent insoluble, melting at 198° C.

By oxidation to, and weighing as, anthracen this sample gives as a mean of these determinations 28·358 per cent of *pure anthracen.*

I hope that this article will cause other chemists interested in the valuation of commercial anthracen to publish their views upon this or any other methods which they may have worked out.

ON THE METHODS IN USE FOR DETERMINING THE VALUE OF VEGETABLE AND ANIMAL OILS.*

By J. J. COLEMAN, F.C.S.,
Associate of the Institute of Engineers, Scotland

(Concluded from page 159).

THE next class of oils in descending value, and which we may call Class III., are the olive oils.

They are known in the market under the name of Gallipoli, Sicilian, Spanish, Mogadore, &c., according to the port from which they are shipped; and they vary in colour from a fair yellow to a deep olive green, and in smell from the sweet smell of salad oil to the powerful odour of the dark varieties.

Their commercial value is fixed chiefly by the fact that, possessing most of the good qualities of animal oleins, as far as being non-drying, they are, with the exception of the finest qualities, inferior, on an average, to the animal oleins in colour and smell, and are contaminated by the presence of mucous, sugary, and albuminous substances.

But there is a specific reason why olive oils preserve their value; that is the dictum of the insurance people, who lay down the law that olive oil is the only oil allowed to be used for greasing wool unless an extra premium be paid. This dictum appears to be absurd, and totally devoid of any justification. The fire insurance people (because our grandfathers thought so) say olive oil is the safest oil for mills, but the experiments of Mr. Gellatly and myself contradict this. The result of this state of affairs is that, of the 30,000 tons or so of olive oil annually imported, a very large proportion of it goes to woollen and worsted mills for greasing wool, and that cheap seed oils are sent from this country to the Mediterranean, where they are said to get mixed with, and returned to us as inferior quality of olive oil.

The statement has been frequently made to him by the highest authorities in the trade that this is the case. A reference to the annual circulars of the London brokers reveals the fact that immense quantities of cotton-seed oil are sent annually from this country to the Mediterranean.

The variations in quality of olive oil are, first, those depending upon the way in which it is crushed, a great cause of variation in quality being dependent upon the care with which the olives are plucked, and the length of time that elapses between their being stored in heaps in a half-fermenting state, and the time at which they are crushed—which affects the colour, smell, and appearance of the oil. Secondly, we have the variations dependent upon actual adulteration.

In regard to the first, the market value is influenced to the extent of many pounds per ton (at least £4 or £5), and the only way to arrive at correct judgment is to obtain familiarity with commercial samples; in regard to the second, actual adulteration, our careful consideration is required.

Excepting the particularly fine qualities, the bulk of olive oils are the cheapest of the so-called commercial non-drying oils, so that we have to look for adulteration with drying oils, fish oils, mineral and resin oils.

Mineral and resin oils must be carefully looked for, because, owing to the dark colour and smell of olive oils, they could easily be overlooked.

It will probably be necessary to refine the oil before looking for mineral oil, which can easily be done; and, if the case is important, an ultimate analysis will be the most satisfactory method of proving presence of the hydrocarbons.

The specific gravity of olive oil is 0·917. Rape oil, a cheaper oil than olive, would make it lighter, and cotton-seed oil heavier, but a proper mixture of the two could be adjusted exactly to the specific gravity of olive, so that we have to depend entirely upon our chemical tests.

The fish oils, then, being proved absent by Calvert's tests or the smell, we have to look for seed oils, and the four tests in practical use are:—

(1). The well-known nitrous acid, or nitrate of mercury test, which is used and relied upon by the leading merchants, and the full details of which can be found in chemical books.
(2). The characteristics of the amides produced by liquid ammonia.
(3). Fehling's tests of the rise of temperature produced by mixing with concentrated sulphuric acid.
(4). The characteristics of the action of solution of carbonate of potash on the oil.

Olive oil appears to be going out of use for lubricating machinery to a great extent. Its sugary or mucilaginous constituents are liable to ferment and make the oil acid, which, however, can be prevented by refining the oil, bringing it up, however, in cost to that of the animal oleins.

An oil used to adulterate olive oil largely is Lisbon seed oil, which is inferior to olive oil in viscosity, and is presumably like other seed oils detected by the above tests. It closely resembles olive oil in appearance.

It is an important question, how far these inferior oils, such as Lisbon seed oil, cotton-seed oil, sunflower oil, &c., can be used for wool-greasing and Turkey-red dyeing; and until the insurance people remove their restrictions we cannot get accurate knowledge, as the woollen people can only use them surreptitiously or pay higher premiums.

We now pass on to Class IV., rape oils, of which about 20,000 tons are crushed annually in this Kingdom, and about the same quantity is annually imported.

The commercial position of these oils is fixed by their being slightly inferior in non-drying properties to olives, but superior to them in smell and appearance.

Rape oils, in fact, are the border-land between drying and non-drying oils, and, notwithstanding their slight tendency to gum, are used most extensively for engine and machinery lubrication, as well as for burning in lamps.

Two kinds are known in the market—brown rape, or the oil as expressed from the seed, and called sweet oil; and the same, after treatment with sulphuric acid, and steaming, washing, and filtering, and called refined rape oil. These oils have assumed immense commercial importance from the quantity in which they can be produced.

There are several varieties of the genus *Brassica*, from which they are produced, and the oils expressed vary also slightly in gravity. The variety cultivated in France and Belgium gives an oil about 0·912 sp. gr., whilst that cultivated in North Germany gives a sp. gr. of 0·915, and the seed crushed in England, and imported from all parts of the Continent and the East Indies, gives an oil of about 0·914 to 0·916 sp. gr. This difference in specific gravities of rape oils is also accompanied by a similar slight variation in viscosity.

It is important to notice the limits within which the sp. gr. of rape oil varies, because too much importance cannot be attached to this testing of the specific gravity

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* Communicated to the Chemical Section of the Philosophical Society of Glasgow.

It should never exceed 0·916; if it does, we may be sure of the presence of one or some of the following oils, viz.:—The fish oils, which are easily detected by the smell or Calvert's tests; or, what is much more probable, other seed oils of a more or less drying character, which may be called fancy seed oils, amongst the chief of which are ground nut, sesame, sunflower, cress-seed, hemp-seed, cotton-seed, Niger-seed, and linseed oils, and possibly cocoa-nut olein, all having a sp. gr. ranging between 0·920 and 0·935. Thus, if rape oil indicates 0·918 sp. gr., it points out to the probable presence of even 50 per cent of these oils, and the smell and colour might be only very slightly affected. These seed oils, with the exception, perhaps, of ground nut, and perhaps cocoa-nut olein, deteriorate rape oil, by adding to its gumming properties. Ground nut oil and cocoa-nut olein being of commercial value equal to rape oil, they are scarcely likely to be present.

But, amongst all these adulterants of rape oil, cotton-seed oil is the most likely to be present. When refined, it is about the same colour as rape oil, and even superior to it in smell. It is a more drying oil than rape oil, but not so drying as linseed oil.

It is produced to the extent of some 17,000 tons annually in this country, and it is very puzzling to account for where it goes to, as the public scarcely ever hear of it under its proper name. Much, no doubt, is consumed by soap makers, for which it does very well. Its market value is always considerably under that of rape oils, and even sometimes below that of linseed or the drying oil proper.

The ease with which cotton-seed oil can be detected in lard or tallow olein and in olive oil has been made evident. It is equally easy to detect in rape oil.

(1). It increases the specific gravity (mineral and resin oils being proved absent).
(2). It raises the freezing-point of rape oil, pure rape oil being perfectly liquid at 32° F.

The other tests applicable are those for estimating the drying properties of the oil or its tendency to gum, either by the blotting-paper test or by small capsules of the oil exposed to 200° F.

Finally, the commercial value of refined rape oil is about £2 per ton more than that of unrefined.

Class V. is represented by linseed oil, the drying oil proper, of sp. gr. 0·937 at 60° F., and of which about 40,000 tons annually are crushed in this country.

From its dark colour, mineral and resin oil must be carefully looked for, and in their absence fish oils are easily detected by smell or Calvert's tests.

By far the most likely adulterants will be cotton-seed or Niger seed oils, which may be recognised.

(1). By decreasing the specific gravity.
(2). Materially raising the freezing-point.
(3). Decreasing the drying properties, which can be proved as before indicated.

Class VI., the fish oils, have a commercial value inferior to the other oils, principally because of their "stink." They are generally considered non-drying oils, so that, if free from smell, they might be applied to most purposes for which other oils are used. At present their use is limited to soap-making, especially for soft soap, greasing leather, greasing jute before spinning (for which several thousand tons annually are consumed), burning in coal-pits, and other purposes where smell is not of much consequence. Rape oil and paraffin oil have almost superseded them for household lamps.

Their price is to some extent regulated by their odour, and partly by their colour and viscosity. The thicker kinds, Northern whale and cod oil, being best adapted for leather, whilst the thinner kinds, as seal oil, are preferred for burning purposes.

The fish oils are not much liable to adulteration, because there are no oils, as a rule, sufficiently cheap for the purpose, except occasionally cotton-seed oil, and perhaps very seldom linseed oil, which would not injure them for soap-making, but would spoil them for burning or lubricating.

They, however, may be mixed with each other, some varieties, as porpoise oil, herring oil, and East Indian fish oil, being much cheaper than others. The points, then, to observe are:—

(1). Looking for mineral and resin oil.
(2). Examining the drying properties of the sample.
(3). Examining the viscosity.

The subject having been considered from the chemist's point of view, rather than the engineer's, it may be remarked that a paper by the author read before the Institute of Engineers of Scotland, November, 1872, deals with the increasing applications of mineral oil on account of economy, more particularly in reference to giving it sufficient viscosity to enable it to be used for heavy machinery.

The author has to express his acknowledgments to Mr. W. H. Hatcher and other friends for information connected with this paper.

ON THE NATURE OF THE CHEMICAL ELEMENTS.*

By M. BERTHELOT.

I think the hypothesis of a progressive decomposition of all substances through increasing temperature, bringing first compound substances to the elements known to chemists, and then again to yet simpler elements, is to be enunciated with reserve.

Simple substances, as we know them, have certain positive characters not belonging to compounds; such are the relation between specific heat of a substance, its gaseous density, and its atomic weight, relations independent of the temperature.

Simple gases, with the same volume and pressure, all absorb nearly the same quantity of heat, to be raised one degree, which seems to me to answer to a like increase of *vis viva*. With the same volume their absolute weights are, moreover, proportional to their atomic weights. Hence, a relation between the atomic weights and the specific heats of the elements; it is Dulong and Petit's law, discovered, as we know, by a study of solid substances.

Now these elements tend to retain their specific heat in combinations. It was long since remarked that the product of the specific heat of a solid compound substance by its atomic weight, that is to say, its atomic specific heat, scarcely differed from the sum of the analogous products in the case of its elements, a relation fully verified by the researches of Regnault, Neumann, and Kopp. If we suppose, with Dulong, that the atoms of all the elements have the same specific heat, we see that the atomic specific heat of a solid compound body will be equal to this common value multiplied by the number of atoms forming the compound.

The same relations are found to exist in the case of compound gases formed without condensation, such as bioxide of nitrogen, chlorhydric acid, and carbonous oxide. More than this, M. Clausius, and most physicists who have been occupied with the mechanical theory of heat, suppose that this relation must be general for the specific heats of compound gases taken at constant volume and in the state of perfect gas.

Without going beyond the domain of experience, however, it may be remarked, on the one hand, that the atomic weights of compound gases, determined by purely chemical considerations, occupy, in general, the same gaseous volume; and, on the other, that the quantity of heat necessary at constant pressure to elevate 1 degree, a certain volume of a gas which is compound and formed with condensation, is, without exception, superior to the quantity of heat absorbed by the same volume of a simple gas under the same pressure; the difference is greater the more complex the constitution of the gas.

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* *Apropos* of a communication from Mr. Lockyer.

This being allowed, it is easy to assign the characters which would be presented by one of the substances now supposed simple, if it were really formed by the union of several others of our elements, or by the condensation of several atoms of the same element, that combination or condensation being supposed comparable to those which give rise to actual compound substances.

If the case were that of one of our gaseous substances, wrongly thought elementary, it should be formed without condensation by the union of its two hypothetical elements; for the compound gases formed with condensation are the only ones that present the same specific heat as simple gases with the same volume. All other gases have a specific heat, much greater and tending towards the sum of those of their elements. But, on the other hand, the atomic weight of the pretended element would be equal to the mean of the atomic weights of the components, and not to their sum. Whence it follows that their cannot exist an element such that its atomic weight is formed by the union of a certain number of atoms identical with those of another element in the manner of our actually known compounds; there is no polymeric element playing the same chemical *rôle* as the non-condensed element whence it is derived; that is, in the sense of polymeric compounds of organic chemistry, the atomic weight of which is the sum of the atomic weights of their components.

To take an example:—We may compare a series of elements, the atomic weights of which are nearly multiples one of another. Such are—Hydrogen, with atomic weight = 1; oxygen, about 16; nitrogen, 14. Now, if oxygen resulted from the association of 16 atoms of hydrogen, just as bioxide of nitrogen results from the association of 1 volume of nitrogen and 1 volume of oxygen, it ought to occupy a volume nearly sixteen times as large; otherwise the specific heat of hydrogen, as measured by M. Regnault, would not satisfy the laws of specific heats of compound bodies. Similarly, nitrogen should occupy a volume fourteen times as large. We thus see that the laws of gaseous specific heats, determined by experiment, establish a profound difference between our actual elements and their known or probable combinations: this difference is independent of temperature.

The same differences exist in the case of solid compound substances compared with solid elements. Let there be a series of similar elements, multiples of the same unit, such as the thionic elements:—

Sulphur, the atomic weight of which is equal to	$16 \times 2 = 32$
Selenium, about " "	$16 \times 5 = 80$
Tellurium " "	$16 \times 8 = 128$

The atomic weights of these elements are absolutely defined,—by their gaseous densities, taken at a temperature sufficiently high; by their combinations with the same group of elements, such as hydrogen and the metals. In particular, they form with hydrogen—

Sulphydric acid	S_2H_2
Selenhydric acid	Se_2H_2
Tellurhydric acid	Te_2H_2.

At first sight it appears that we may compare this series of elements with a series of carbides of hydrogen, variously condensed, but having equal chemical properties. Such are—

Ethylen, the atomic weight of which is equal to	$14 \times 2 = 28$
Amylen " "	$14 \times 5 = 70$
Caprylen " "	$14 \times 8 = 112$
Ethalen " "	$14 \times 16 = 224$

The atomic weights of these carbides are absolutely defined,—from the physical point of view by their gaseous density; from the chemical, by their combination with the same group of elements, such as hydrogen, chlorine, &c.

Between the series of thionic elements and the series of ethylenic carbides the parallelism is evidently very close; and an opinion held by good authorities seeks, on these analogies, to connect certain series of simple substances with series of compounds.

But this relation only extends to the specific heats. In fact, the specific heats of sulphur, selenium, tellurium, taken at unit weight, are in inverse ratio of their atomic weights; that is to say, that their atomic specific heats have the same value, conformably to Dulong's law.

On the other hand, the specific heats of the polymeric carbides cited are nearly the same at unit weight, according to the determinations of them known; that is to say, that their atomic specific heats are multiples one of another, being proportional to their atomic weights.

Between the compound bodies that we know and their polymers there is, then, this general relation—that the atomic specific heat of a polymer is nearly a multiple of that of the body not condensed.

On the other hand, the atomic specific heat remains constant for the various elements, the atomic weights of which are multiples one of another. The same difficulties exist fort he hypothesis of a simple substance, the atomic weight of which is the sum of the atomic weights of two others.

There is, therefore, between the physical properties of the elements and those of their compounds, a singular opposition; and it is the more important, that the notion of specific heat is a translation of general molecular work, by which all substances are maintained in equilibrium of temperature with one another. This opposition does not at all prove (and I wish not to be misunderstood on this point) the theoretical impossibility of decomposing our actual elements; but it better defines the conditions of the problem, and leads us to think that the decomposition of our simple substances, if it may occur, must be accompanied by phenomena of quite a different order from those which have hitherto determined the destruction of our compound substances.

NOTICES OF BOOKS.

Questions in Chemistry and Natural Philosophy. Given at the Matriculation Examination of the University of London from the year 1864 to June, 1873. Classified according to the syllabus of subjects of examination, by C. J. Woodward, B.Sc. London: Simpkin, Marshall, and Co. Birmingham: Cornish Brothers.

So much trash has been recently published in the form of handbooks, text-books, and other compilations especially intended for the preparation of candidates for examinations, that we are disposed to look rather suspiciously on anything that includes in its title or sub-title any reference to any kind of examination whatever. There is but one safe method of qualifying for such examinations, that is, to study the subject fairly and conscientiously, and scrupulously avoid all the dodges and dishonesty of any and every system of cramming. The student may safely take it for granted that any elementary treatise on any scientific subject which is published for the avowed purpose of preparing for any particular examination, or for examinations in general, is a bad book, and just one of those which he should most carefully avoid.

These remarks apply to the *study* of the subject itself. Still, however, it is quite possible that a given student with a fair amount of sound knowledge may take a lower place in an examination than another student who has rather less knowledge; and this difference may arise from the fact that the first has neglected the legitimate preparation by which he may acquire the art of displaying to best advantage in an examination paper the knowledge he does possess. It is perfectly legitimate and most desirable that, *after* having sufficiently mastered the subject of his studies, he should specially prepare himself for coolly and effectively undergoing the ordeal of an examination upon it. How should this be done? The answer is simple enough. Like every other kind of skill, the art of working examination papers can only be attained by actual practice. The little book before us is admirably and most legitimately adapted to the purpose of affording the student the materials for self-examination, and for exercise in the attainment of this art by those who have already passed through the indispensable previous preparation of conscientious study.

Even to those who are studying the elements of chemistry and natural philosophy, for their own sakes such a series of questions are very valuable, especially where an intelligent teacher can be obtained who will go through the students' answers and make the errors they may contain the subjects of careful lessons. By this means some ugly gaps in the student's knowledge may become visible and be filled up, and serious mistakes that might be made thereafter will be thus prevented.

As Mr. Woodward says, "it is a fair inference that if a candidate can, *without help*, work all, or nearly all, the questions that have been given for the last ten years, he will be likely to pass the examination of the eleventh year." If he cannot work these questions, let him follow Mr. Woodward's advice, and "go over the subject a second or third time, until the questions can all be worked satisfactorily." This is especially necessary to those unfortunate students who have been deluded by examination cram-books, and have sought to qualify themselves for scientific examinations by learning science by rote.

These questions are published by permission, and we strongly recommend every candidate for the Matriculation Examinations of the London University, and for the Oxford Middle Class and other examinations, to obtain and use them in accordance with Mr. Woodward's directions.

A Handbook of Practical Telegraphy. By R. S. Culley, Memb. Inst. C.E., Engineer-in-Chief of Telegraphs to the Post Office. Adopted by the Post Office and by the Department of Telegraphs in India. Sixth edition, revised and enlarged. London: Longmans, Green, Reader, and Dyer. 1874.

This edition is a handsome volume, embellished with 144 well-executed woodcuts of descriptive illustrations, and several full-page designs of instruments in use, showing the methods of connecting them up to line. There are also six large folding plates. Mr. Culley has adopted an excellent plan of using initial type for whatever statement is important, so that, as the reader's eye roams over the pages in quest af facts, his attention is at once directed to the salient points of each chapter. The volume contains an exceedingly clear description of the new method of telegraphing on the "duplex system," whereby two stations can signal their messages to each other at the same time. The work is in all respects a handbook of practical telegraphy.

Traité des Matieres Colorantes Artificielles Dérivees du Goudron de Houille. Par P. Bolley and E. Kopp. Traduit de l'allemand et augmenté des travaux les plus récents par le Dr. L. Gautier. Paris: F. Savy.

This work, like the "Traité des Dérivés de la Houille" of Girard and De Laire, treats of the so-called coal-tar colours practically and theoretically. Nevertheless, the two works differ in their plan. Bolley and Kopp enter at length into the preparation of artificial alizarin, of corallin, rosolic acid, resorcin, gallein, and a variety of other colours, whilst Girard and De Laire confine themselves more strictly to the aniline dyes, properly so-called. Hence the library of every tinctorial chemist should contain both. Bolley and Kopp commence with an account of coal-tar and its rectification, and consider, in successive chapters, phenol, its homologues and derivatives; benzol, its homologues and derivatives, including aniline, toluidin, xylidin, cumidin, and the manufacture of their red, blue, violet, green, yellow, black, and grey compounds; naphthalin and its derivatives; anthracen and its derivatives; and, finally, the colouring matters obtained from phenols. An Appendix describes artificial colouring of different origins, such as cyanin, the aloes colours, rufigallic acid, and murexide. There is an elaborate bibliography and a good index, in which the work of Girard and De Laire is wanting. The student will find here many valuable indications concerning fields for future research, and the practical man will meet with not a few hints of unquestionable importance.

The appearance of such a work so soon after that of Girard and De Laire is a new proof, if proof were still needed, of the lively interest in the progress of applied chemistry felt on the Continent. Meantime, what are we doing? Instead of developing native talent, we are more and more placing the management of our chemical manufactures in the hands of foreigners, just as the Romans, in their decline, filled up the ranks of their legions with stranger mercenaries. *Absit omen!*

CORRESPONDENCE.

ADULTERATIONS OF FOOD.

To the Editor of the Chemical News.

Sir,—Referring to the last paragraph in your notice of Mr. Atcherley's book, I trust you will allow me to state that, as I am not—so far as I know—as yet a fit inmate for a lunatic asylum, I never gave out the statement that brandy sinks in water. What I did state, some three years ago, was that a liquid called *jerupigia*, manufactured from elder, &c., had been long used for giving colour and body to inferior port, and that if floated with certain precautions upon water, wine so "ameliorated" would sink and colour the water more rapidly than the genuine article. This test was none of mine, but one taught me by a Portuguese wine-factor as in common use by men in his trade, and I believe I so stated at the time.—I am, &c.,

John Muter.

231 and 325, Kennington Road, S.E.
April 13, 1874.

ADULTERATIONS OF FOOD.

To the Editor of the Chemical News.

Sir,—In your article on Dr. Atcherley's work on food adulteration two considerable errors have escaped notice. (1) On page 13 a definition of beer is given, the author stating that malt and hops are the only substances permitted by law. Since the repeal of the hop duty any bitter may be used instead of hops, and, as is well known, in most large breweries during scarce hop seasons various bitters are used to replace hops. This with good effect; since by the taste the difference cannot be perceived, whilst the bitter used is quite as wholesome as that of the hop. The Licensing Act schedules a number of substances *not* to be used. (2) The illustrations at the end of Dr. Atcherley's book, representing tea-leaves and the tea-plant, may certainly, for aught I know, represent some leaves and plant, but are as certainly totally unlike those of the tea-plant.—I am, &c.,

C. Estcourt, F.C.S.

Manchester, April 11, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 23, 1874.

Undulatory Movement of a Train of Waggons due to Shock.—M. Resal.

Acid Waters Arising in the Volcanoes of the Cordilleras.—(Continued.)—M. Boussingault.

Determination of the Densities of Vapours.—M. Sainte-Claire Deville.—The author gives reasons for preferring Gay-Lussac's method to that described by M. Croullebois.

Process Devised by M. Dulong for Finding the Density of Vapours.—M. Dumas.—M. Dulong used a vessel of known capacity immersed in a bath of known temperature. The vessel contained a very small quantity of the substance experimented on, and communicated by a capillary tube with a barometric tube immersed in mercury.

Observations with Reference to the Late Communication from M. Clausius on the Equation $\int \frac{dQ}{T} = 0$.—M. Ledieu.

Memoir on the Swimming-Bladder, with regard to Station and Locomotion of the Fish.—M. Moreau.—Of changes in volume of fish some are passive (from external pressure), others active (through efforts of the fish). The author discusses passive variations of the perch, whose bladder is quite closed, having no aërial passage. In one experiment, the fish being captive, he proved, by means of special apparatus, that its volume varies directly as the pressure it is subject to; and it varies sensibly, not only with great, but with very slight changes of pressure. It further appears, from a tracing, that the perch did not act on its bladder in movements executed by it freely (rising and sinking) in the containing vessel. The results from other kinds of fish will be given later.

Observations on a Recent Memoir of M. Helmholtz on Aërial Navigation.—M. de Fonvielle.—M. Helmholtz has sought to determine the energy of the motor forces necessary in a steam balloon inflated with pure hydrogen in order to give it a velocity in the face of a slight breeze. He concludes that to give the aërostat a velocity of 30 kilometres per hour, there must be expended about 100 per cent of the motor force necessary to obtain a velocity of 21 kilometres per hour in a large German steamer (on which observations were made); but the volume of the aërostat must be forty-two times the displacement of the vessel. The chief difficulties, according to M. Helmholtz, are the great size which the aërostat must have, and the weight of the motor screws. M. de Fonvielle remarks that the rapid rupture of thermal equilibrium by action of solar rays, the sudden surcharges through fall of rain, friction from currents, electric phenomena, and many other obstacles, which M. Helmholtz has left out of account, complicate the case. His reasoning would only hold good if the moving bodies had the same geometric form, and merely differed in scale of construction. In the ship he only considers the immersed part, and as the aërostat is completely immersed, his reasoning would only be applicable if it were shown that the dynamic conditions of movement, force, velocity, and friction were the same where the large steam vessel moved under water altogether. Now it seems demonstrated that, other things equal, the movement would be much more easy under water, and the velocity would be greater for the same quantity of force developed, supposing such a vessel could be made. Some fish go faster under water than the most powerful steamers, though their organic heat, which is the source of their dynamic force, is very small. M. Helmholtz's conclusions, then, based on a study of superficial movement, are much too high, though it may be impossible to say how much. Again, he neglects the retardative effects of a partial vacuum behind the large aërostat, and the condensation in front. Some further objections are urged.

Permanent Magnetism of Steel.—M. Bouty.—Consider two bodies, A and B, subjected to the same inductive force but invariably conducted with one another. After cessation of the force the body A remains subject to the action of B, and retains, besides the residual magnetic moment which would remain in it after removal of A, a moment of the same or of contrary direction, produced by influence of B, and which is permanent only so long as the connection of A and B subsists. This magnetic excess may be called the *sub-permanent magnetic moment.* In the experiment of a bundle, ruptured parallel to the axis, the sub-permanent magnetism is in contrary direction to the permanent magnetism. It is of the same direction in the case of a cylindrical needle ruptured by a plane perpendicular to its axis, and of which the two fragments are separated and united end to end. This agrees with experiment.

New Apparatus for Registering the Direction of Clouds.—M. de Parville.

Distribution and Determination of Thallium.—Dr. T. L. Phipson.—The author considers that thallium is more generally distributed than is commonly supposed. He has detected it especially in metallic cadmium, in Norwegian and Spanish pyrites, and in many other ores and industrial products. The procedure for its separation is simple. It must always be determined as protoxide, but in the ordinary course of a quantitative analysis, thallium, if present in the body under examination, is always peroxidised and escapes along with the iron in whatever form the latter is separated. The author dissolves the ore in *aqua regia*, dilutes with water, and precipitates with sulphuretted hydrogen. The filtrate is brought to a boil, air being excluded as far as possible. It is then treated with carbonate of soda in slight excess, and filtered rapidly while still hot. From the filtrate sulphuret of ammonium precipitates all the thallium as sulphuret.

Presence of Metallic Silver in Galena.—Dr. T. L. Phipson.—The author found a sample of galena interpenetrated with slender filaments of metallic silver. The ore was obtained from the Phœnix Silver-Lead Mine, in Cornwall. Metallic silver was observed only in specimens from the exterior parts of the vein. Within, where the galena was mixed with carbonate of lead in fine crystals, no silver was found.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 47, 1873.

Bloch's Feculometer.—This apparatus, for determining the amount of water in commercial samples of starch, has been already noticed in the Chemical News.

Disorganisation of Cotton, and of Vegetable Fibres by the Action of Alkalies and Oxidising Agents.—M. Jeanmaire.—Vegetable tissues saturated with chromic acid, with chromate of potash, and sulphuric acid, or with permanganate of potash, and washed after the reduction of the oxidising body has taken place, though presenting then no apparent alteration, are found to be seriously weakened when treated with any alkali. It is not essential that the oxidising agent should be acid in order to produce this reaction. The same result takes place with the alkaline ferricyanides. Chromate of baryta or of lead fixed upon a fabric, and then passed through sulphuric or oxalic acid, acts similarly. In the reaction with chromic acid not a trace remains upon the cotton. Chromic acid appears to oxidise or dehydrogenise the fibre, forming a new body, which is disorganised under the influence of an alkali. These reactions enable us to decide if a white or a yellow upon a vat-blue ground has been produced by means of a resist, or by a chromic discharge. In the latter case, the fabric when steeped in an alkali, is not affected in its white parts. Red prussiate discharges have the advantage of remaining unaffected in similar circumstances, owing to the comparatively slow action of the ferrid-cyanides.

Bread Containing Liebig's Extract, and Gluten Bread for Diabetic Patients.

Drying of Tissues by means of Steam.—M. Bastaert.—Superheated steam is recommended instead of heated air for drying textile fabrics, and is said to leave them in a more supple condition.

New Apparatus for Lighting with Gasoline.—Langsdorff and Meyer.—This paper should have been accompanied with an illustration.

Archives des Sciences Physiques et Naturelles, December 15, 1873.

Elliptical Polarisation of Light, and its Relations to the Superficial Colours of Bodies.—M. Wiedemann. (Extract).—The author finds that superficial colours change considerably with the nature of the media in contact with which they are produced, and therefore the data hitherto obtained only are limited to the case of air. From his own and other researches M. Wiedemann formulates several conclusions, among which are these:—Metalliform bodies behave in their transparent parts, as regards retardation of light with various angles of incidence, like transparent bodies, and in opaque portions like metals. Colours which are most strongly reflected present, generally, the most intense elliptic polarisation (where the reflection is in air or *in vacuo*). The principal angles of incidence undergo the most rapid modifications for wave-lengths corresponding nearly to the bands of absorption. In opaque bodies the tangent of the principal angle of incidence is equal to the index of refraction, and hence it is in the neighbourhood of the bands of absorption that the indices of refraction increase or diminish most rapidly. The calculation of the indices of refraction according to Brewster's law, gives, in the case of solid fuchsine a very pronounced anomalous dispersion (the differences between the indices of refraction of the line C and F is about thirty-one times greater than in sulphide of carbon). From these results M. Wiedemann proceeds to explain some other peculiarities of substances with superficial colours. His work establishes a connection between the phenomena of these substances on the one hand, and the principal angle of incidence and the proportion of the principal amplitude on the other. The problem of substances with superficial colours is reduced to a question of elliptical polarisation, and the connection of this with absorption.

Meteorological Congress at Vienna in 1873.

Journal de Physique, November, 1873.

Equality of Fundamental Numerical Constants of Optics and Electricity.—M. Potier.—An account of Maxwell's treatment of this subject in his recent work on electricity and magnetism.

Articulated Beam with Rectilinear Movement.—M. Peaucellier.—In steam navigation it is desirable to have engines with short beam and yet a considerable piston course, and the instrument here described meets these conditions.

Loss of Electricity by Air.—M. Brion.—The author cites some experiments by M. Charault, made several years ago, as dissipating any doubt (still suggested) as to the generality of Coulomb's law.

Note on the Model of a Vernier.—M. Mannheim.

Reflection Galvanometer.—M. Raynaud.—First part of an instructive paper.

Repertorium fur Experimental Physik, band ix., heft 5.

Determination of the Temperature Coefficients of Steel Magnets.—M. Wild.—The author shows the importance of this determination in magnetic measurements; compares three different methods of making it; the first depending on oscillations, the second on deflection, and the third (preferred as the best) on the change of position of equilibrium of a bifilar-suspended magnet with differences of temperature. M. Wild asserts that the present condition of our magnetic instruments, and of our knowledge of the laws of magnetism, is not sufficient for determining the horizontal intensity of terrestrial magnetism with a certainty of $\pm 0{\cdot}0001$.

Reply to the Remarks of M. Bredichin on the Field of Vision and Magnification of Optical Instruments.—M. Lubimoff.

Fall-myographion.—M. Jendrassik.—In this instrument, described with considerable details and illustration, the principle of Atwood's machine is introduced in the measurement of phenomena of muscular contraction.

Regulator for Electric Currents.—M. Mascart.

Sound-Decomposing Apparatus for Schematic Explanation of Sound Analysis by the Ear.—M. Jendrassik.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, September and October, 1873.

Limits of Capability of the Microscope.—M. Helmholtz.

Reduction of the Annual Temperature-Curve, to the Conditions Determining it. (Second paper.)—M. Dove.—The author discusses observations of summer heat, the average, and deviations from it; and one fact elicited is the progressive (unsimultaneous) character of these deviations over a large extent of surface.

Unsere Zeit., January 1, 1874.

Plutonism and Vulcanism of the last few years in Germany.—Dr. Karl Müller.—An instructive paper on recent earthquake phenomena and their cause.

Liebig's Annalen der Chemie und Pharmacie. January 19, 1874.

Nitro-Compounds of the Fatty Series.—Victor Meyer.—A very lengthy paper, announced as the commencement of a series. The author begins with nitrous ether and nitro-compounds, describing experiments on their formation. He next enters upon the action of tin and hydrochloric acid upon amylen dinitroxide, the constitution of hyponitric and nitric acids, the specific volume of nitrous ether, and experiments on the introduction of nitrogen-oxygen radicals into fatty bodies. In the second section the author treats of the nitrated hydrocarbons of the fatty series; nitroethan; action of iron and acetic acid upon nitroethan; action of alkalies upon nitroethan; the metallic derivatives of nitroethan; nitromethan; normal nitropropan; pseudo-nitropropan; nitropentan; action of iodethyl upon nitrite of silver; iodethyl and sulphocyanide of silver; mono-brom-nitroethan; dibrom-nitroethan; action of fuming sulphuric acid upon nitroethan; action of common sulphuric acid.

Certain Derivatives of Solid Dibrom-benzol.—V. Meyer and C. Wurster.—An examination of the action of ammonia upon nitro-dibrom-benzol. The authors did not succeed in converting dibrom-benzol into phenylen-diamin, but have obtained phenylen-diamin from brom-nitro-amido-benzol.

Investigation into the Constitution of Certain Chloral Compounds.—V. Meyer and L. Dalk.—The authors have examined the action of chloracetyl upon chloral hydrate and upon chloral; the action of chloracetyl upon chloral-alcoholate; that of anhydrous acetic acid upon chloral; that of glacial acetic acid upon chloral; and the behaviour of chloral and trimethylamin.

Preparation and Examination of Crystalline Xylol (Para-Dimethyl-Benzol).—Paul Jannasch.—Pure para-xylol melts at 15°, and boils at 136° to 137°. It is composed of—

Carbon	90·56
Hydrogen	9·43
	99·99

As by-product the author obtained crystalline ditolyl. Crystalline xylol, when oxidised with dilute nitric acid, yields para-toluilic acid, fusing at 173°. The authors also obtained mono-brom-para-xylol by the reaction of 2 equivalents of bromine to 1 of para-xylol.

Preparation of Para-Brom-Toluilic Acid from Crystalline Brom-Xylol.—The authors prepared this acid from crystalline brom-xylol by oxidation with chromic acid dissolved in glacial acetic acid, and examined its barium and calcium salts.

Mutual Behaviour of Oxygen and Water.—Em. Schœne.—The author concludes from a series of carefully conducted experiments that—(1) Ozone is partially destroyed by passing through water. If dry, ozonised oxygen is simply collected over water, the ozone present is diminished by about one-fourth. If passed through water for a longer time the loss of ozone is greater. The loss of ozone is the more considerable the longer the gas is in contact with the water, and the greater the surface exposed. (2) Ozone is absorbed by water in a considerable degree, even at the ordinary temperature of the atmosphere. (3) On passing dry ozonised oxygen through water much more ozone disappears than is absorbed by the water. The decrease of the proportion of ozone is, therefore, only very slightly determined by absorption, but must be considered as a consequence of the destructive action of water. (4) Ozone does not convert water into peroxide of hydrogen. As regards the loss of ozone in ozonised oxygen gas on standing for a longer or shorter time in contact with water, the author concludes—(1) If ozonised oxygen is left in contact with water, the ozone is gradually converted into ordinary oxygen. In three days the original proportion of ozone is reduced to one-half, and in fifteen days mere traces of ozone remain. (2) The transformation of ozone into oxygen in contact with water and at common temperatures is attended with an increase of bulk.

Formation of Metallic Sulphides by the Sulphides of Ammonium and of the Alkalies.—E. Priwoznik.—The oxides of copper in contact with polysulphides of ammonium are changed into ammonio-persulphide of copper, and subsequently, if there is free access of air, into sulphide of copper. Oxide and peroxide of lead are changed by sulphide of ammonium, at common temperatures, into crystalline sulphide of lead. Under similar circumstances peroxide of thallium yields immediately amorphous sulphide of thallium. Oxide of cadmium, both the crystalline blue-black and the brown variety, are converted by polysulphide of ammonium almost completely into sulphide of cadmium slowly at common temperatures, but more rapidly with the aid of heat. Protoxide of manganese yielded with yellow sulphide of ammonium at 100° sulphide of manganese of a flesh-red colour. Hydrated peroxide of manganese yields with the above sulphide a flesh-red sulphide, with the evolution of heat. The native peroxide (pyrolusite) yields a green sulphide. Oxide of iron and chromic oxide are not perceptibly affected by this reagent.

Peroxide of Chrome.—Hugo Schiff.—Remarks on the author's mode of obtaining this compound, viz., by evaporating a mixture of bichromate of potash and oxalic acid with nitric acid.

Benzylic Acid and Diphenyl-acetic Acid.—R. Symons and Th. Zincke.—A lengthy paper not adapted for abstraction.

Simple Apparatus for Filtering at an Elevated Temperature.—Dr. A. Horvath.—A soft leaden tube is wound in a spiral round the funnel. One end of it is then connected with a flask or retort full of water placed over a source of heat. The current of steam passing through the spiral maintains a high temperature in the funnel.

Reimann's Farber Zeitung, No. 5, 1874.

This number contains an essay on shoddy; a paper on certain varieties of blue vats; and a notice on dyeing Turkey reds with artificial alizarin, by Armand Mueller. The author remarks that goods dyed with artificial alizarin are often unequal and dull. The fault is rarely to be found in the alizarin, and then depends on the weakness of the paste or on the presence of sulphuric acid. Alizarin of this kind was obtained from an English establishment. Another cause of failure is the speed of the dyeing process. If the goods are well mordanted, and the beck is at a boil the colour is absorbed so eagerly that it is spotty and dull, being merely smeared upon the surface. If tannin is used after aluming the goods, take a fine yellowish red, but if too little tannin is employed, and especially if alum or nitrate of alumina is also deficient, the tone is bluish, which is very objectionable. The chief fault in mordanting is the use of too strong a caustic soda. In this case a pale yellowish rose shade is obtained. Deficiency of cow-dung, and the use of an oil not sufficiently rancid, likewise give a blue tone to the cloth. If the goods are dried at too low a temperature, and not sufficiently exposed to the air after each treatment with oil, the red will be meagre. The air must be very damp, not cold, and should contain ozone. The pieces must be hung in a light, but not sunny place. There are further instructions for a Havanna-brown on silk, a pansy on garments with cotton warps, and for finishing silks.

Artificial Alizarin in Printing.—Hitherto artificial alizarin has been chiefly used as a steam colour, but it can also be employed like garancin and fleurs de garance. To prepare the dye-beck, chalk to the extent of 1 per cent of the alizarin paste to be employed is stirred into the beck, which is heated to 70° R. The goods, previously printed with the mordants, aged, dunged, and washed, are unwound into the beck, and heated quickly to a boil. The dyeing is complete in ten minutes. The alizarin in the spent bath in combination with the excess of chalk is precipitated with hydrochloric acid, and recovered from the precipitate thus formed. The dyed pieces are washed in warm and cold water, and then three times, using each time ¼ lb. soap per piece; the two first soap-baths at 50° and the third at 70° R. They are then placed in a weak solution of chloride of lime for half an hour at 25° R., washed again, dried, and finished.

Bulletin de l'Academie Royale des Sciences, des Lettres, des Beaux-Arts de Belgique, Nos. 9 and 10.

Note on the Electrical Phenomena of the Heart.—Dr. J. P. Nuel.—Some new facts are here brought to light, among others, the positivity of the apex of the intact heart.

Meteorological Congress at Vienna.

Note on the Tendency of the Greater Axes of Cometary Orbits to take a Given Direction.—M. Houzeau.—The author finds that they show a well-marked tendency to become parallel to the heliocentric meridian of 102° 20′, or the double meridian of 102° 20′ and 282° 20′. A fact so well characterised certainly depends on a general cause, and one can hardly doubt that the phenomenon will develop more and more in the future.

Universal Meteorographic System.—M. van Rysselberghe.—This paper describes an ingenious meteorograph invented by the author, and now in action at Ostend, which registers at once the direction of the wind, its velocity, the atmospheric pressure, and the temperature of the air. He proposes, also, to make it register hygrometric and magnetic phenomena.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved apparatus for analysing gas. Louis Hengist Orsat, engineer, 19, Rue de la Victoire, Paris. May 22, 1873.—No. 1853. This invention relates to apparatus for analysing gases, consisting of a measuring-tube connected at bottom by a flexible pipe with a vessel containing water, which can be raised or lowered so as to expel gas from, or draw gas into, the measuring-tube. This tube is connected at top by pipes provided with stopcocks with several bell-jars immersed in solutions suitable for absorbing various gases, in which vessels are placed numerous glass tubes or rolls of wire gauze, which present large absorbent surfaces. The gas to be analysed having been drawn into the measuring-tube, is thence forced into, and drawn back from, the successive bell-jars a sufficient number of times to have its several gaseous ingredients absorbed therein, the difference of measure indicated in the measuring-tube furnishing the quantitative proportions of those ingredients. With the gas-tubes are connected, with proper stopcocks, a water-pipe and funnel for cleansing the interior of the apparatus.

Improvements in the treatment of copper pyrites and iron ores to free them wholly or partly from earthy or extraneous matters. John Richardson Francis, merchant, member of the firm of J. C. Richardson and Co., Swansea, Glamorgan. (A communication from François Alexandre Hubert La Rue, Quebec, Canada). May 23, 1873.—No. 1865. The object of the invention is to separate quartz, shales, siliceous and other extraneous earthy matters from copper pyrites and iron ores. The invention consists in pulverising the ore, then roasting it, though this may in some cases be dispensed with, then heating it with carbon or reducing gases to ensure at least a partial reduction of the iron ore, which then becomes magnetic: then passing the material thus treated through a magnetic or electro-magnetic machine, to separate the ore from the earthy residue. In the case of copper pyrites, the iron which is rendered magnetic is separated in combination with the copper ore.

An improved process for the production of aluminium. Richard Werdermann, civil engineer, Princes Street, Surrey. May 29, 1873.—No. 1933. The said invention consists in a novel process for producing the metal aluminium without employing metallic potassium or sodium.

An improved process for the conversion of chlorides and fluorides of alkaline metals and alkaline-earth metals into oxides, hydroxides, and carbonates. Richard Werdermann, civil engineer, Princes Street, Surrey. May 29, 1873.—No. 1934. This invention consists mainly in a new process for effecting the direct conversion of chloride of sodium into caustic soda without the employment of sulphuric acid.

Improvements in treating sewage or other liquids or substances containing nitrogen, phosphorus, or their compounds, in order to deodorise or precipitate the same, and obtain useful products therefrom. Joseph Townsend, manufacturing chemist, Glasgow, Lanark, N.B. May 31, 1873.—No. 1967. This invention has for its object the deodorising and purifying, or partial purifying, of sewage or other liquids or substances containing nitrogenous matter or phosphorous compounds, and consists in certain modes of using alumina, lime, magnesia, phosphoric acid, or combinations or compounds thereof.

A new and improved utilisation of linseed and other ingredients for the manufacture of certain medical compounds. Samuel Kay and Thomas Kay, chemists, Stockport, Chester. May 31, 1873.—No. 1975. The lozenge (styled a "linseed lozenge") is made by mixing highly concentrated extract of linseed with pounded sugar; the product or mass in a plastic state, after being rolled and moulded to the desired form, is dried in a heated room, or in any other convenient manner. Another lozenge (styled a "chlorolinseed" or "klorolinseed lozenge") is made by taking the mass in a plastic state, compounded as above, and adding thereto in due proportions any medicament, such as chlorodyne, strong chloric ether, or chloral hydrate, preference being given to a chlorodyne made with morphia meconate combined with an expectorant, as ipecacuanha or antimony, in approved doses. The mixture (styled "compound essence of linseed") contains in a concentrated state, the fluid extract of senega, scilla, papavera, chiretta, or other tonic, ipecacuanha or antimony in wine, or both in approved official doses. The clear liquor is emulsified with linseed by decoction. The product strained is further medicated with a distillate of star aniseed, cherry laurel, tolu balsam, gum benjamin, sulphuric or chloric ether, and sufficient mucilage to produce a mixture perfectly homogeneous. The pill (designated "vegetable pills of the linum catharticum") contains the extract of purging linseed (or, as it is commonly called, mountain flax), evaporated to a plastic state, and mixed with other vegetable substances, as rhubarb, aloes, myrrh, cardamoms, mandrake, hyoscíamus, and gentian extract, to which, for the purpose of keeping the ingredients soluble and active, is added a due proportion of castile soap.

Improvements in the manufacture of cements. Reverend Granville Hamilton Forbes, Rector of Broughton, Northampton. June 4, 1873.—No. 1999. The inventor mixes refuse or foul lime from gas-works, for instance, with any marl or fine clay containing the necessary quantity of silica and alumina for the purposes of the said invention above referred to, in the proportion of about from 70 to 80 parts of the lime to about 30 or 20 parts of the clay in every hundred pounds by weight of the compound. I do not, however, limit myself (says the inventor) to the above proportions, as the quantity of sulphur in the foul lime leads to variations.

MEETINGS FOR THE WEEK.

Monday, 20.—Medical, 8.
—— Society of Arts, 8. Cantor Lectures.
—— London Institution, 4.
Tuesday, 21.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Anthropological, 8.
—— Royal Institution, 3. Prof. Rutherford, "The Nervous System."
Wednesday, 22.—London Institution, 7.
—— Society of Arts, 8. Mr. W. C. Aitken, "On Progress Recently Made in Ornamental Processes Connected with Metallic and Other Industries."
Thursday, 23.—Royal Institution, 3. Mr. W. N. Hartley, "On the Atmosphere."
—— Royal, 8.30.
—— Royal Society Club, 6.
Friday, 24.—Royal Institution, 9. Mr. C. W. Merrifield, "On Sea Waves."
—— Society of Arts, 8. Dr. C. R. A. Wright, F.C.S., "On Pyrites as a Source of Sulphur, Copper, and Iron."
—— Quekett Microscopical Club, 8.
Saturday, 25.—Royal Institution, 3.

TO CORRESPONDENTS.

Errata.—Page 161, column 1, lines 12 and 19 from bottom, *for* methyl-ethyl-keton *read* methyl-hexyl-keton.

J. Andrews.—Dr. Morfit's treatise on soap is published by Messrs. Trübner and Co.

L. J. B. and Co.—An advertisement in our columns will be sure to elicit answers.

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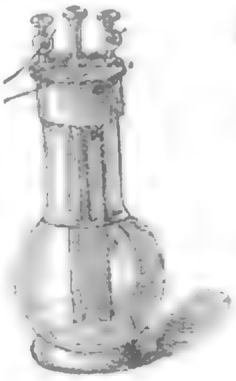

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THE CHEMICAL NEWS.

VOL. XXIX. No. 752.

ON ANTIMONY TRIBROMIDE.

By R. W. EMERSON MACIVOR.

THIS compound, the only known combination of bromine with antimony, is most easily procured by the gradual addition of powdered metallic antimony to dry bromine, contained in a tubulated glass retort, until light is no longer emitted, and then submitting the product to distillation. It may also be obtained by heating an intimate mixture of antimonious sulphate with dry potassium bromide, when the following reaction takes place:—

$$Sb_2(SO_4)_3'' + 6KBr = 2''Sb'''Br_3 + 3K_2SO_4.$$

Antimony tribromide forms upon cooling a colourless solid substance, crystallising in needles, and fusing at 90° C. to a pale greenish-yellow-coloured liquid, which boils, under an atmospheric pressure of 760 m.m., at or near 283° C. When in the melted condition it has a specific gravity = 3·473 at 96° C. It attracts moisture from the air with great avidity, and is immediately decomposed by water. It dissolves in hydrochloric and hydrobromic acids, alcohol, and ether. Carbon disulphide also dissolves it, and its solution in this menstruum, when allowed to evaporate, deposits the compound crystallised in beautiful quadrangular needles. It is readily decomposed by strong nitric acid, even in the cold. When in the liquid state it dissolves sulphur, but does not form a definite compound with it. When subjected to the action of a stream of dried ammonia it absorbs a quantity of the gas, and a yellow non-crystalline substance results, consisting most probably of $SbBr_3.NH_3$. When antimony bromide is intimately mixed with dry potassium iodide, and the mixture is heated, orange-red vapours are formed, which condense on the cooler parts of the apparatus in the form of magnificent scarlet-coloured transparent scales, consisting of antimony tri-iodide.

Antimony tribromide is, as already mentioned, readily decomposed by water, the products of the action being free hydrobromic acid and an oxybromide. The composition of the latter varies with the temperature of the water used for its precipitation. The slimy white precipitate formed when $''Sb'''Br_3$ is acted upon with cold water consists of a definite oxybromide, mixed with varying quantities of undecomposed tribromide. In order to separate the tribromide, the precipitate should be collected on a filter, dried in an air-bath, and then washed with pure carbon disulphide until no more tribromide is dissolved out. The substance remaining on the filter has then a composition corresponding to the formula $Sb_4Br_2O_5$, or $2SbBr_3.5Sb_2O_3$, as the following results of the analysis of two different samples show:—

	Found.		Calculated.
Sb ..	66·89	66·85	67·04
Br ..	22·21	22·17	21·99
O ..	10·90	10·98	10·97
	100·00	100·00	100·00

The granular white precipitate formed by pouring the liquid tribromide into boiling water has a constant composition, and consists of a compound of 10 molecules of the above oxybromide with 1 of the tribromide. These figures are the results of the analysis of two specimens of this body:—

Sb	65·38	65·41
Br	24·16	24·32
O	10·46	10·27
	100·00	100·00

The theoretical percentage composition of a substance having the formula $10Sb_4Br_2O_5.SbBr_3$ being—

Sb	65·45
Br	24·08
O	10·47
	100·00

By washing this compound with carbon disulphide, 1 molecule of the tribromide is dissolved out, and the oxybromide $Sb_4Br_2O_5$ remains.

Antimony oxybromide is decomposed when heated to about 300° C., $SbBr_3$ being volatilised, and antimonious oxide remains behind. It is also decomposed by long-continued washing with water, hydrobromic acid being dissolved out, and antimonious oxide left. It is insoluble in alcohol, ether, or carbon disulphide, but is easily dissolved by hydrochloric acid. A solution of tartaric acid also dissolves it.

67, Park Road, Glasgow,
April 10th, 1874.

AN EXPERIMENT ON SEA-WATER.

By E. SONSTADT.

IN the postscript to a letter commenting on the discovery of vanadium in trap rocks, I stated that when sea-water was saturated with pure iodate of potassium, vanadium, and a metal resembling, or that probably was, osmium, could be detected in the precipitate. I had trusted that some one having better opportunities than I have for doing such work would have been moved to examine sea-water in the way indicated; and I thought that such an examination, properly carried out, could not fail to yield very interesting results. As it is, however, it seems to me worth while to place on record such small progress as I was able to make myself in the separation from sea-water of this osmium-like metal, and in the examination of the very small quantity I was able to obtain.

The iodate of potassium used in these experiments was prepared by concentrating a solution of the ordinary iodate, so that it should crystallise. The iodate that crystallises out is coloured, and when examined with borax before the blowpipe in sufficient quantity gives a coloured bead. The supernatant liquid is then filtered, and concentrated so as to give another crop of crystals, which latter are not only colourless, but remain so on exposure to the air (if protected from dust), and do not colour a bead before the blowpipe. The pure iodate was dissolved in boiling water to saturation, and the solution added to sea-water in such proportion that the liquid when cold should be about saturated.* A day or two is allowed for the precipitate to form. This precipitate, when filtered off, and exposed moist to the air for a few days, gives out a very disagreeable odour, which reminded me of the odour sometimes perceivable when platinum wire is melting in a hydrogen flame. This, together with a peculiarity about the odour of the chlorine evolved when the precipitate is treated with hydrochloric acid, directed me to look for osmium. After some preliminary experiments, to guide me in overcoming the difficulty arising from the presence of iodine in the precipitate (which is essentially iodate of calcium), I proceeded as follows:—

The precipitate was put into a retort, and a large proportion of pure hydrochloric acid poured in. The chlorine, which was copiously evolved, was received in a strong solution of sulphide of ammonium. When the action in the retort had nearly ceased, heat was applied, and gradually raised so as to keep the liquid in constant ebullition. As the temperature rose, chloride of iodine came over, and as iodine and iodide of sulphur began to separate in the receiving vessel, fresh additions were made of sulphide of ammonium. After a while a permanent dark brown precipitate began to make its appearance. It was necessary to add sufficient sulphide of ammonium from time to time to re-dissolve precipitated sulphur. The brown precipitate increased most when the liquid in the retort had attained a high boiling-point and was strongly coloured by iodine. A little nitric acid was then poured into the retort, and the distillation continued as long as was safe to the vessel. A small quantity of a black precipitate appeared in the retort, which precipitate remained to the end.

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* In some experiments I have evaporated the sea-water to a fourth of its volume before adding the solution of the iodate of potassium, so as to economise the latter.

Next, a quantity of iodate of potassium from the stock that furnished what was used in the sea-water experiment was distilled with hydrochloric acid of the same stock as before, and the distillate was received in sulphide of ammonium of the same stock as before. Similar quantities were used, and the experiment in all respects was conducted as before. There was no permanent coloured precipitate in the receiving vessel. This appeared conclusive proof that the sulphide obtained in the previous experiment was the sulphide of a metal derived, not from the reagents taken, but from the sea-water.

The sulphide obtained in the first-mentioned experiment was collected on a filter, washed with solution of sulphide of ammonium and with a little water, and was drained and cautiously dried. The sulphide was then put into a porcelain boat, which, placed in a tube, was heated to low redness while hydrogen was transmitted over it. A black, very light powder remained. A portion of this powder, heated in a closed tube, neither melted nor showed other sign of change at the highest temperature the glass would bear. But when a portion was placed on platinum foil, and held so as to touch the side of a spirit-lamp flame, it instantly passed off in fumes having a powerful disagreeable odour, allied to that of osmium, but there was no flash of light or increase in the illumination of the flame against the assay. I repeated the experiment several times, always with the same result. A little osmium, which I procured for comparison, when similarly held in the flame always gave the flash described by Fresenius. In other respects the phenomena were similar.

I tried to make some experiments in the wet way, but could do no satisfactory work with the few centigrammes that I obtained in all as the product of several experiments. Moreover, the greater part of this small quantity was consumed in the trials with the flame.

My best experiment gave 0·0124 grm. of the metallic powder from 2 litres sea-water. In this experiment sulphuretted hydrogen was passed for a long while through the partially decomposed sulphide of ammonium in which the distillate was received.

ON THE

CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.*

By THOMAS ROBERTSON OGILVIE, F.C.S.,
Joint Public Analyst, Greenock.

I propose to give the details of the examination of specimens of the preserved mutton imported into this country from Australia and New Zealand. A short time ago a considerable discussion was carried on in some of the journals regarding the dietetic and economic value of preserved mutton, and various statements were made to the effect that it is considerably deficient in the nourishing constituents of butcher's meat, and that labouring men consume nearly double the quantity they would eat of English meat in order to satisfy their appetite. Other statements testifying to the highly nutritive properties of this article were also given; but the whole correspondence was of a very general nature, and no evidence of a scientific character was produced to establish the real value of this substance, which has now become a staple article of food.

The following analyses were made in order that a definite estimate may be formed of the nourishing properties of preserved mutton compared with those of home mutton and other kinds of animal meat.

Much research has been bestowed on the discovery of a method of preserving the flesh of cattle reared abroad so that it may be imported in a fresh and palatable state. About 250 patents have been taken out in Great Britain, as well as a large number in the Colonies. Only one method, however, has been practically successful, and it is a modification of the old process of heating the meat in tins.

In carrying out this process, the meat is placed in tins, which, with the exception of a small aperture for the escape of air and steam during the operation, are sealed and made air-tight. The tins are placed in a chloride of calcium bath having the boiling-point of about 260° F., and kept there for four hours, then closed, and after remaining in the bath for another half-hour, are ready for shipment. The special object of this treatment is to ensure that the meat will remain fresh by the removal of the air and the destruction of all "microscopic germs."

There are three companies whose manufacture is specially known in this country, viz., the New Zealand Meat Preserving Company, the Australian Meat Preserving Company, and the Melbourne Meat Preserving Company, and a number of tins of the meat prepared by these companies were purchased in the ordinary retail way, and samples taken from the several lots for examination. When the tins are opened without being heated, their contents may easily be separated mechanically into three distinct portions, viz., jelly, fat, and lean, the proportions of which vary in every tin. Average samples of these separately, and also of the whole mixed together, were taken from a number of the tins of each manufacture. Four samples were thus obtained from each of the three kinds for analysis, viz.:—

(*a*). Jelly or gelatin.
(*b*). Fat.
(*c*). Lean.

(*d*). A sample of the three together, as found in the tins.

To enable me to make a comparison of the results with the composition of home mutton, I carefully selected pieces of the latter from three different animals, with the aim that they should be as nearly as possible average specimens of mutton as retailed in butcher's shops. The several specimens were freed from bones, and the whole finely minced together, and an average sample taken for analysis. Further, I procured a number of cans of extract of meat prepared by Liebig Company, mixed their contents, and from the whole took an average portion for examination, with the object of arriving at an estimate of the comparative value of the jelly in the tins of preserved meat. I thought it well to do this, as many of the working classes are in the habit of purchasing the jelly and the lean, and using them separately.

The following is the method of analysis adopted in the examination of these substances. The quantities given are those used in the analysis of the mutton, and were altered to suit the varying proportions of the constituents in the fat, jelly, and extract. The mutton was prepared by being thoroughly minced and well ground together.

(1). *Moisture.*—Two grains were placed in a watch-glass, dried at 212° F., and the loss noted as moisture. Some authorities suggest that 230° be adopted, but I found that all the moisture is driven off at this temperature.

(2). *Fat.*—Two grains were digested in a small stoppered bottle with successive portions of ether, which were transferred to a weighed flask, the ether removed by distillation, and the fat dried and weighed.

---

* Read before the Chemical Section of the Philosophical Society of Glasgow, February 23, 1874.

(3). *Albumen.*—Twenty-five grains were placed in a beaker, covered with cold water, and allowed to stand for an hour with occasional stirring. The whole was then transferred to a piece of well-washed linen, the watery extract gently pressed through, and placed in a basin. The operation was repeated once with cold water, then three times with boiling water, the mass allowed to cool before being pressed in the linen. In the examination of raw or uncooked flesh, the filtrate was made slightly acid with acetic acid, and gently heated to about 170° F. to coagulate the albumen, then filtered through a weighed filter, and the albumen well washed and dried at 212° F.

The filtrate from the preserved mutton could not contain any soluble albumen, as in the process of preserving it was heated to about 260° F. During the evaporation of the watery extract, however, a small quantity of a body resembling fibrin separated, which was transferred to a weighed filter, washed, dried at 212° F., and called "soluble fibrinous matter."

(4). *Extractive Matter.*—The filtrate from the albumen was gently evaporated in a small basin, dried in the water-bath at 212° F., and weighed as the "total extractive matter."

It was then carefully removed from the basin, digested in a small flask with successive portions of 90 per cent alcohol, and the residue weighed as the watery extract. The alcohol solution was gently evaporated, and the residue weighed as the "alcoholic extract."

(5). *Fibrin.*—The residue, after digestion with cold and warm water was carefully removed from the linen cloth, dried in a large watch-glass at 212° F., and weighed as "fibrin."

(6). *Nitrogen.*—In portions of the extractive matter and fibrin the nitrogen was estimated in the usual way, by combustion with soda-lime.

(7). *Mineral Matters.*—Fifty grains of the mutton were dried, charred at a low red heat, and repeatedly digested with boiling water, the clear filtrate made up to 250 c.c., and phosphoric acid, sulphuric acid, chlorine, and alkalies, estimated in separate portions. The residue was thoroughly incinerated, and noted as insoluble ash.

The following is a table of the results of the analyses of the the various substances examined.

(A). *Comparative Composition of Foreign Preserved Mutton and Home Mutton.*

(*a*). *Water.*—The percentage of water in each of the three specimens of preserved mutton is higher than that in the home mutton, thus:—

No. 1 contains	59·26 per cent.
" 2 "	61·48 "
" 3 "	61·57 "
Home mutton contains	52·59 "

This difference was to be expected, as during the preserving process a special addition is made to the tins of a quantity of jelly or gelatin, the greater proportion of which is water.

(*b*). *Fat.*—There is also a wide difference in this constituent—

No. 1 contains	19·62 per cent.
" 2 "	14·62 "
" 3 "	15·79 "
Home mutton	28·88 "

No other element will vary more, and different samples may contain higher or lower proportions than these. I do not consider, however, that the preserved mutton should contain more than 14 to 20 per cent, as that is certainly a large enough quantity. It must be remembered that the home mutton was raw, and that before cooking it in the ordinary way portions of the fat would be removed.

(*c*). *Extractive Matters.*—The three varieties of preserved are richer in these matters than the home mutton.

	Alcoholic Extract.	Watery Extract.	Total.
No. 1	2·47	4·47	6·94
" 2	2·87	4·05	6·92
" 3	3·12	3·82	6·95
Home mutton	2·28	1·85	4·13

(*d*). *Albumen and Fibrin.*—The albumen in the preserved mutton has been rendered insoluble by the boiling it undergoes during the preserving process, and as it cannot in that state be separated from fibrin, the two are classed together in the analyses.

	Albumen and Fibrin.
No. 1	14·16 per cent.
" 2	16·92 "
" 3	16·39 "
Home mutton	14·40 "

One of the preserved specimens shows nearly the same proportion as the home mutton, while the other two contain 2·52 and 1·99 per cent respectively in excess.

During the evaporation of the solution of the extractive matters from the preserved mutton a small quantity of a body separated out, which is shown in the analyses as "soluble fibrinous matter," thus:—

No. 1 gave	1·27
" 2 "	2·32
" 3 "	1·59

Home mutton was cooked at the same temperature as the "preserved," and yielded 1·59 per cent of this substance, which I believe does not differ in composition or condition from ordinary fibrin.

(*e*). *Mineral Matters.*—The preserved contain larger quantities of these matters also than home mutton.

	Soluble.	Insoluble.	Total.
No. 1 contains	0·654	0·444	1·098
" 2 "	1·019	0·543	1·562
" 3 "	0·705	0·160	0·865
Home mutton	0·303	0·150	0·453

No. 2 contains a larger quantity than any of the others; the excess, as will be seen from the table of analyses, consists of common salt.

All the specimens of preserved mutton, therefore, are superior to the home mutton in the respect that they contain larger proportions of the specially valuable and nutritious ingredients.

It still remains to notice the—

(B). *Comparative Composition of Liebig's Extract of Meat, and the Jelly or Gelatin in the Tins of Preserved Mutton.*

The preparation known as Liebig's Extract consists of the juice of flesh from which the water, fat, gelatin, albumen, and fibrin have been more or less removed. It consists, therefore, essentially of the extractive matters of flesh.

The "jellies" contain the same bodies, but in smaller quantities, thus:—

	Alcoholic Extract.	Soluble Mineral Matter.
No. 1 contains	3·60	1·165
" 2 "	3·56	1·485
" 3 "	3·61	1·148
Liebig's extract	53·04	22·170

The jellies closely resemble each other in composition, and contain, on an average, 1 part of alcoholic extract for 14·77 in Liebig's extract, and 1 part of soluble salts for 17·5 parts in the extract.

In discussing these analyses, a very natural point to consider is the special function which each of the constituents of animal flesh serve in the human economy. Our knowledge, however, on this subject is extremely limited and undefined, owing very much to the great difficulty of experimenting on the effect of the several components of butchers' meat on a body so sensitive and complicated as the human organism. The peculiar merit of butchers' meat is that it contains, in well-balanced

Comparative Statement of Analyses of Foreign Preserved Mutton (including Jelly, Fat, and Lean), Home Mutton, and Liebig's Extract of Meat.

	Foreign Preserved Mutton.												Home Mutton, uncooked.	Liebig's Extract of Meat.
	Average of whole contents of Tin.			Jelly or Gelatin.			Fat.			Lean.				
	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.		
Water..	59·26	61·48	61·57	88·07	88·43	87·95	28·15	33·60	24·51	61·38	63·20	65·42	52·59	17·20
Fat	19·62	14·62	15·79	0·83	0·29	1·45	65·77	61·11	68·34	12·48	6·70	6·52	28·88	0·14
Extractive matters:—														
(1). Alcoholic extract, including creatin, inosic acid, lactic acid, mineral matter, and undefined substances	2·47	2·87	3·12	3·60	3·56	3·61	0·93	1·38	1·29	2·63	3·09	3·44	2·28	53·04
(2). Watery extract, including gelatin, mineral matter, and undefined substances	4·47	4·05	3·82	6·88	6·98	5·25	1·77	2·70	1·87	4·67	3·87	3·04	1·85	29·22
Soluble fibrinous matter	1·27	2·32	1·59	—	—	—	—	—	—	1·77	3·22	2·21	—	—
Soluble albumen	—	—	—	—	—	—	—	—	—	—	—	—	3·22	—
Insoluble „	—	—	—	—	—	—	—	—	—	—	—	—	—	0·40
Myochrome, or colouring matter	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fibrin or syntonin	12·89	14·60	14·80	0·62	0·74	1·73	3·38	1·21	3·99	17·06	19·92	19·37	11·18	—
	99·98	99·94	100·69	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Soluble mineral matter:—														
Potash	0·235	0·298	0·241	0·405	0·440	0·440	0·104	0·184	0·157	0·237	0·315	0·229	0·136	9·78
Soda	0·107	0·193	0·098	0·238	0·332	0·207	0·061	0·112	0·073	0·110	0·191	0·088	0·065	2·48
Phosphoric acid	0·160	0·151	0·237	0·325	0·371	0·332	0·084	0·078	0·118	0·151	0·133	0·250	0·056	7·89
Chlorine..	0·152	0·377	0·129	0·197	0·342	0·169	0·057	0·242	0·069	0·167	0·414	0·137	0·046	1·76
Sulphuric acid	—	—	—	—	—	—	—	—	—	—	—	—	—	0·26
Insoluble mineral matter	0·444	0·543	0·160	0·250	0·110	0·440	0·064	0·064	0·157	0·698	0·646	0·116	0·150	0·91
	1·098	1·562	0·865	1·415	1·595	1·588	0·370	0·994	0·574	1·363	1·699	0·820	0·453	23·08
Nitrogen in extractive matters	0·931	0·913	0·862	—	—	—	—	—	—	—	—	—	0·536	—
Nitrogen in albumen and fibrin	1·809	2·314	2·206	—	—	—	—	—	—	—	—	—	1·947	—
	2·740	3·227	3·068										2·483	9·05

proportions, the several constituents of our bodies; and I think it is a fair and legitimate method of arriving at the constituent value of meat offered to the public from a new source, such as the preserved mutton under consideration, to compare it with home-grown butchers' meat of good quality.

One conclusion we may draw from the many experiments that have been made on the dietetic value of fat, gelatin, albumen, and fibrin is this, that when any of them are taken alone they cease to have the nourishing effect which they would have if taken together as they exist in flesh. These bodies are co-relatives.

Thus fat is not only indispensable in the process of repair of all cellular and fibrous matter, but is also necessary for the digestion of the other elements of food. Gelatin alone cannot support nutrition, but, as Voit has shown lately, it is highly valuable in conjunction with certain proportions of albumen and fat. But even gelatin, albumen, fibrin, and the other life-sustaining bodies, when eaten alone or mixed together, entirely fail in supporting the system if destitute of certain mineral substances, such as phosphate of potash and chloride of potassium. These bodies are present in comparatively small proportions, but are nevertheless of primal importance, as without them the other bodies could not be ingested. It is thus of the highest consequence that the preserved meat sent from the Colonies should have the normal composition of good butchers' meat, and that care be taken that none of the constituents, such as fat and gelatin, be present in undue proportions.

What, then, is the value of Liebig's extract of meat and the jelly of the preserved mutton, seeing they are nearly devoid of such nourishing bodies as fat, albumen, and fibrin? They are certainly not "foods," as they contain nothing that can renovate the organic tissues. They are stimulants of the same class as tea and coffee, and contain an alkaloid, creatin, corresponding in chemical relation and constitution to theine and caffeine.

This peculiar body, creatin, is also associated with other active principles, such as lactic acid, inosic acid, and certain bodies which as yet are undefined. They are all included under the term alcoholic extract, and, along with the potash salts present, are believed to have the special property of stimulating muscular strength, just as the other alkaloids named excite mental activity. Hence, the restorative power on invalids of Liebig's extract and beef-tea (which is virtually the same as the extract). The jelly of the preserved mutton also has the same quality, but in a less degree, as it contains the same bodies, but in much smaller proportions.

Owing to the high price of Liebig's extract, it cannot become available to the working classes for the making of soup, but if such jelly could be sold at a cheap rate it might come into use, especially by the operatives in cotton factories, who at present use tea to an extent which is highly injurious. If taken with butter and bread it would act, not only as a vital restorative, but as real nutriment. The gelatin alone would be useless for the support of life, but in conjunction with the salts present in the jelly, and the fat or butter, would be eminently valuable as an article of nourishment.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 16th, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, Messrs. J. Smyth, Howard Barrett, H. L. Greville, T. M. Nishigaiva, G. H. Beckett, and A. J. Greenaway, were formally admitted Fellows of the Society.

The donations to the library were then announced, after which the names of Messrs. Charles Edward Bean and H. H. B. Shepherd were read for the first time.

For the third time—Messrs. Frederick W. Fletcher

Alfred A. Wolff, and William Pearce, jun., who were then ballotted for and duly elected.

The first paper, "*On Aqua Regia and the Nitrosyl Chlorides,*" was read by the author, Dr. A. W. Tilden, who was induced to undertake this research in hopes of being able to obtain nitroso-compounds by the action of nitrosyl chloride, NOCl, on organic bodies. As no process existed for the preparation of this substance in quantity, the author devised the following:—The gases evolved on gently heating aqua regia were dried by calcium chloride, and then passed into concentrated sulphuric acid to saturation. The product, when exposed to a low temperature, deposits crystals having the composition $NOHSO_4$. These melt at 85° to 87°, and possess the characters of the ordinary sulphuric acid chamber crystals. Attempts to obtain a dinitrosyl sulphate, $(NO)_2SO_4$, were unsuccessful; on mixing either the crystals or the sulphuric acid saturated with the aqua regia gases with dry sodium chloride, and gently heating, nitrosyl monochloride is at first given off—$NOHSO_4 + NaCl = NaHSO_4 + NOCl$. When this has ceased, the application of a stronger heat causes the evolution of torrents of hydrochloric acid. The pure nitrosyl chloride thus obtained is an orange-yellow gas, which may be condensed to a mobile liquid of a deep orange colour, boiling at $-8°$. It attacks platinum and gold, but only very slowly. The existence of the remarkable dichloride, $NOCl_2$, which, according to Gay-Lussac, occurs among the products of the decomposition of nitric acid by hydrochloric acid, seemed doubtful, as no compound having any analogy with it is known, except the vanadyl dichloride, $VOCl_2$, of Roscoe. The author endeavoured to prepare this substance by fractionally distilling nitrosyl monochloride saturated with chlorine, but no definite compound could be obtained; a similar result ensued on examining the liquid produced by condensing the gases from aqua regia: from this it would appear that the monochloride is the only definite nitrosyl compound obtainable from aqua regia, the reaction being $HNO_3 + 3HCl = NOCl + Cl_2 + 2H_2O$. Gay-Lussac's dichloride was probably a solution of chlorine in the monochloride. The action of nitrosyl sulphate on potassium bromide does not give nitrosyl bromide, but nitric oxide and a dark liquid which could not be distilled without the evolution of the same gas. It was not further examined.

The President, in thanking Dr. Tilden, said that the subject of which he had treated was one of very great interest to chemists, and the results he had obtained satisfactorily proved the existence of the compound NOCl, which, if he remembered rightly, Gay-Lussac had passed over with very slight notice, his attention being directed to the mixed body which he supposed to be the dichloride. This compound, whose existence Dr. Tilden had shown to be more than problematical, would be the legitimate analogue of nitric peroxide.

In reply to a question of the President, Dr. Tilden said that Roscoe's vanadyl dichloride was a green crystallisable body of definite composition, but, as it did not seem to be volatile, there was no means of determining its molecular weight.

Dr. C. R. A. Wright then read a paper on "*Isomeric Terpenes and their Derivatives; Part IV.*"—1. *On Cajeput Oil,*" by C. R. A. Wright, D.Sc., and T. Lambert. By carefully fractioning oil of cajeput, an oil, cajeputol, was obtained, boiling between 176° and 179°, and having the composition $C_{10}H_{18}O$, isomeric with the citronellol described in Part III. Like the latter, it combines with 2 equivalents of bromine, forming the compound $C_{10}H_{18}Br_2O$, which, when heated, splits up into cymene, hydrobromic acid, and water—

$$C_{10}H_{18}Br_2O = C_{10}H_{14} + 2HBr + H_2O.$$

This cymene, when purified, boiled at 176° to 177°, and, on oxidation, yielded terephthalic acid free from isophthalic acid, so that it is identical with that obtained from the other terpene derivatives.

2. *Action of Pentasulphide of Phosphorus on Terpenes and their Derivatives,* by Dr. C. R. A. Wright. On treating cajeputol with its own weight of the pentasulphide, a vigorous reaction takes place, and a hydrocarbon distils over, which appears to be a mixture of cymene and a terpene, the former predominating. As it seemed probable that the cymene might result from the action of the pentasulphide on the terpene—$C_{10}H_{16} + S = C_{10}H_{14} + H_2S$, the terpene from turpentine oil, boiling at 159°, and hesperidene, boiling at 178°, were digested with an equal weight of phosphorus pentasulphide, when a continuous evolution of sulphuretted hydrogen took place, and much of the hydrocarbon was resinified, but about 30 to 40 per cent distilled over, consisting almost entirely of cymene. It would seem that the class of bodies known as terpenes, and their derivatives of the form $C_{10}H_{16}O$ and $C_{10}H_{18}O$, are closely connected with cymene, so that this hydrocarbon may be regarded as the central form of matter from which these classes of substances are derived by operations similar in character for all members of a given class, but differing apparently in the extent to which energy is involved in each operation respectively.

The President said the Society was much indebted to Dr. Wright for the continuation of his investigations of the ten carbon bodies. It was curious that the vegetable kingdom should yield such a vast supply and so great a variety of the ten carbon bodies, and not other benzene derivatives containing C_9, C_7, &c. He believed that other bodies existed having the same percentage composition as the terpenes, but only half the vapour density, so that they might be considered as five carbon bodies; he would like to ask whether any relation had been made out between these and the ten carbon bodies.

Dr. Wright replied that this subject had been but little examined. It was a curious fact that, although we could obtain the polymerides from the C_{10} bodies, we could not perform the inverse operation, and unpolymerise them, so to speak,—that is, convert C_{15} or C_{20} compounds into C_{10} bodies.

The meeting was then adjourned until Thursday, May 7, when there will be papers "On the Constitution of Urea," by Dr. D. Tommasi, and "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part VII., On the Chlorides of Ethylene and Ethylidene," by Dr. J. H. Gladstone and Mr. A. Tribe.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 24th, 1874.

Rev. William Gaskell, M.A., Vice-President, in the Chair.

"*A Few Observations on Coal,*" by E. W. Binney, V.P., F.R.S., F.G.S. Of late years much has been written on the structure of coal and the various vegetable remains of which it is composed. Observers examining different coals under the microscope have, as might be expected, come to different conclusions. Some of them have found little else than the remains of spores and spore cases, others only scalariform and cellular tissues and a few spores, and a third class little trace of any structure whatever in the specimens they examined. Splint or hard coal would generally afford the results first named, soft caking or cherry coals the second, and cannel coals the third.

Soft coals, yielding a large amount of charcoal enclosed in bright coal, nearly always show plenty of structure in the "mother coal," as well as a few macrospores in the bright portions. Macrospores are nearly always found in abundance in splint and hard coals. In cannel coals they are sometimes found as well as the cellular and scalariform portions of plants.

For many years macrospores were known by the names of spore cases and spores. They could be easily observed by the naked eye in the black parts of the coal, and they were generally considered as sporangia; but Professor Adolphe Brongniart in 1868 described a cone (*Lepidostrobus*

Dabadianus) having sporangia full of very minute spores, in fact microspores, in the upper portion, and sporangia full of macrospores, which had been so long known, in the lower part. These observations of Brongniart have been amply confirmed by specimens from the British coal-fields.

Thirty years ago it was considered that the soft or cherry coals were chiefly composed of the remains of large plants such as *Sigillaria, Lepidodendron, &c.*, while caking coals were formed of plants of a lesser size and much bark, for it had then been observed, and since confirmed, that the outsides of *Sigillaria* and other fossil trees, sometimes reaching to 2 or 3 inches in thickness, were chiefly composed of bright soft coal showing little traces of structure.

In the great lawsuit which was tried at Edinburgh more than twenty years since as to the nature of Boghead coal, much evidence was given as to its structure, some witnesses finding in it scarcely anything else than the remains of vegetables, whilst others found only a stray portion of scalariform structure or a macrospore. Both Boghead and the other brown cannels of Scotland are now generally considered to afford but little evidence of vegetable tissues under the microscope, although numerous remains of *Sigillaria* and other common coal plants can be seen by the naked eye in them. Notwithstanding that they are so rich in volatile matter, and far exceeding other coals in their yield of paraffin and paraffin oils, they contain from 25 to 30 per cent of mineral matter in the form of ash. This circumstance has induced certain scientific men to class them as shales rather than coals, notwithstanding that they have the specific gravity of coals.

Some years since, when describing several fossil cones affording both kinds of spores, he expressed an opinion that the yellow matter seen in the vesicles of Boghead coal was nothing but microspores composed of paraffin or a similar hydrocarbon, and that they were driven off by heat in the form of a yellow vapour, leaving nothing behind but a spongy mass of earthy and carbonaceous matter. The evidence that caused him to come to this conclusion was that the microspores contained in the upper sporangia of *Lepidostrobus Harcourtii* had all the appearance of crude paraffin, and were of the same yellowish brown colour as powdered Boghead coal, and that the latter substance was composed nearly altogether of microspores and mineral matter. So far as his observations extended, microspores had not been observed in coal, although plenty of macrospores, which are generally 1-20th to 1-25th of an inch in diameter, and easily seen by the naked eye, had long been noticed.

He had some time since directed his friend, Mr. J. W. Kirkby, of the Pirnie Coal Company, to examine the Fifeshire seams of coal in search of microspores, most of those beds yielding macrospores in great abundance, and that gentleman had lately furnished him with the specimens now exhibited, both splint and soft coals, but especially the former, affording the two kinds of spores. On burning the yellow coal composed of microspores, a most brilliant flame and a peculiar empyreumatic odour like that from burning Boghead coal were produced, whilst the splint coal full of macrospores only burnt and smelt like ordinary hard coal, thus clearly showing that these two kinds of spores differed very much in their inflammable properties and odours given off, and that such properties were certainly not due to the larger spores, but most probably to the smaller ones.

The compressed lenticular bodies in the splint coal were formerly of oval and spherical forms with a triradiate ridge on one half, and although their exterior was composed of a brown coriaceous substance, their interior was full of white carbonate of lime, or bisulphide of iron, according to the nature of the matrix in which they were found; thus suggesting the idea of their having been filled with granules of starch when in a living state, which it is probable they would have been in case of their being germinating spores.

He and his late partners at Bathgate, when manufacturing paraffin oil there, had tried various means, by subjecting Boghead coal to the action of ethers and naphthas, to dissolve out paraffin from it, but they had never succeeded; so the yellow matter in the coal may probably be changed into paraffin by the heat employed in distillation. Dr. Schorlemmer, F.R.S., who has been so kind as to examine the microspores found in the Muiredge splint coal, is of opinion that they are not composed of paraffin, but some other hydrocarbon. This may, therefore, change into paraffin by the application of heat in a similar way to what the yellow matter in Boghead coal does.

The macrospores are about 320 times the size of the microspores and constituted the germinating spores, while the microspores were the fertilising agents, both having been contained in one cone.

Several specimens of fine bright soft coal, between two and three inches in thickness, taken from the outsides of *Sigillaria* and other fossils trees, were exhibited. In these there was no appearance of charcoal, spores, or vegetable structure, and in every respect they resembled the black shining parts of soft cherry and caking coals, which generally afford no distinct traces of vegetable structure. Hence from his observations he was led to conclude that soft or cherry coal was chiefly composed of the bark, cellular tissue, and vascular cylinders of coal plants, with some macrospores and microspores.

That caking coal had much the same composition, except that it contained a greater proportion of bark in it.

That splint coal had a nearly similar composition, but with a great excess of macrospores.

That cannel coal, especially that yielding a brown streak, was formed of the remains of different portions of plants with a great excess of microspores, which had long been macerated in water.

These conclusions were arrived at merely as to the composition of the different kinds of coal. No doubt each seam would be materially affected by the nature of the roof, whether the latter was an open sandstone or a close and air-tight black shale or blue bind, for the former would allow the free escape of gaseous matter, and the latter would prevent its escape. It is well known that the character of the roof has a deal to do with the quality of the coal under it.

CORRESPONDENCE.

DEHYDRATION OF COBALT SALTS.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxix., p. 161, there is a report of the meeting of the Chemical Society which contains a notice of Mr. Noel Hartley's interesting communication upon "The Cobalt Bromides and Iodides." In that paper it is shown that the change of colour in the salts named is due to the state of hydration. In the discussion that followed Mr. Clowes pointed out that dehydration of cobalt salts in solution took place in sealed tubes when submitted to a temperature above 100° C.

Not having been present at the meeting I do not know if these remarks were put forward as original observations, but I think it may be as well to point out that the dissociation of water of hydration of all salts, although in solution, always takes place providing the "thermanalytic point" (temperature of dissociation) is reached. The thermanalytic point will vary with the amount of dilution, but is generally above 100° C., and therefore such phenomena can only be reached when the solutions are heated under pressure. The production of anhydrous salts of cobalt in aqueous solutions is detailed amongst other experiments in my original paper, which was read at the Royal Irish Academy, in January, 1872, and which appeared in your periodical in the same year (*Vide Proceedings of the Royal Irish Academy*, vol. i., series 2, p. 247).—I am, &c.,

Charles R. C. Tichborne.

Dublin, April 15, 1874.

SALT-CAKE OR CRUDE SULPHATE OF SODA.

To the Editor of the Chemical News.

Sir,—Your correspondents appear to have overlooked the fact of the presence of HCl, which would of course be thrown down on addition of $AgNO_3$, together with the NaCl, and if not taken into consideration the percentage of undecomposed NaCl will in many cases be overrated. This error may be avoided by first treating a portion of the crude sulphate with NH_4HO and igniting, then determine NaCl in usual way. Mr. Tenniswood does not make any allowance for $CaSO_4$, which is invariably present to a considerable extent (say from 0·80 to 1·20 per cent).

Subjoined is analysis of average sample, which may be useful for comparison:—

Sodium sulphate	96·50
Sodium chloride	0·75
Hydrochloric (free acid) ..	0·54
Sulphuric " " ..	0·46
Calcium sulphate..	1·00
Ferric oxide	0·30
Silica	0·25
Moisture	0·20
	100·00

The silica, ferric oxide, and calcium sulphate may, for practical purposes, be set down at 1·50 per cent.—I am, &c.

Wm. Simmonds.

Oldbury, near Birmingham,
April 15, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 2, 1874.

Descending Movement of Solar and Terrestrial Trombes, and on the Formation of their Opaque Sheaths.—M. Faye.—A reply to Dr. Reye. Distinguish in the terrestrial whirlwind the rapid rotation of the "tool" (to use a former comparison), the movement by which it nears or goes away from the obstacle (the ground), and the progressive narrowing of the helices downwards. The gyratory movement, and formation of conical funnels, are easily explained by difference of velocity in currents. The whirlwind, once formed, stores up, in a narrowing space, the *vis viva* resulting from the inequalities of velocity, carries it downwards to the ground, while travelling in the direction and with the mean velocity of the current. As to the mode of vertical transmission, conceive, first, a solid ring rotating in a fluid. At each point of the turning surface the layer in contact will be forced in the direction of rotation, and the molecules thus forced will be replaced immediately by others which are near, but do not participate in the movement. But the reactions thus produced will not be equal in all directions. Above the ring the work of the fluid replacing the displaced layer is favoured by gravity, while below it is hindered. There is thus a slight excess of pressure from above downwards, increasing with the velocity of rotation. The solid ring would gradually descend (supposing the experiment realisable), and if it were a little lighter than the fluid this excess of pressure might dominate over its ascending tendency; but if the velocity of rotation fell below a certain limit the ring would rise again, more slowly, however, than if it were not turning. Suppose, now, the ring fluid; the effects will be somewhat different. Each element, besides its rotation about a vertical axis, will be solicited by light pressure from above to turn about a horizontal axis, and this second rotation will be combined with the first. The resulting axis of rotation will be inclined at a small angle, and, the pressure being constant, the plane of gyration of the element will wind conically downwards. In other words, this element and all that follow will take the figure of a descending helicoidal spiral. We see, then, that the turning ring will be decomposed into threads like those of a screw having a descending movement; so long, at least, as the vertical reaction from above exceeds the contrary reaction. If the rotation diminish this effect will also; if the density of the ring be less than that of the surrounding fluid the helicoidal movement, stopped for a moment, may become ascending. This difference in density will not occur in liquids; it is only in gases that the descending movement may become an ascending one. But do not misconceive; a gaseous whirlwind may rise again to the point whence it descended, but there are no ascending whirlwinds, in the ordinary sense of the word, unless in very special circumstances that are here out of the question; and even then the phenomenon shows neither the progress nor the energy of the trombes, properly so-called. Next as to the contraction of the descending helices. On the one hand, rotation of the helices produces centrifugal force; on the other, the air imprisoned in the trombe is involved in the descending gyratory movement, and causes within a sensible diminution of pressure, while the motion in which the exterior air in contact with the helices is involved is counterbalanced by afflux of the surrounding fluid. Accordingly the horizontal actions at each point have, in general, a direction from without inwards; these combining with the vertical actions, we find the final resultant to be inclined at once downwards and towards the axis, so as to produce both descent of the helices and their progressive contraction. These are consequently formed on a surface of revolution of conical form, the contracted part being below. But if the density of the air carried down by the trombe do not increase as quickly as that of the medium, and if the movement of descent be weakened, the inverse effect may occur; the centrifugal force preponderating will enlarge the bottom of the trombe into a sort of divergent watering-pot (*arrosoir*) of which the parts which become independent of the whirlwind will rise again into the atmosphere. Such is the general case in the sun, where there is not a resistant ground to cut short the vertical propagation of the trombes. Nearly all the foregoing applies to water-courses as to media, but in the atmosphere a new influence is added; the air of the upper regions descending in a trombe is colder than the layers it crosses. It condenses the moisture of the interior air, and therefore the elasticity of this will diminish. We find quite analogous effects in the sun. And about the trombe this cooling extends to some distance beyond all appreciable movement, a sheath of vapours may thus be formed. The author proceeds to show how the phenomena described by M. Mouchez in a recent letter are explicable only on his theory, and to indicate how the phenomena of our water-spouts would appear to a spectator at a considerable distance from the earth.

Meteorology of the Month of January, 1874, at Tongourt.—M. Sainte-Clair Deville.—Complete sets of meteorological apparatus have lately been set up at Tongourt and at Biskra, in Southern Algeria, under the author's direction, and the two months' observations now had promise a rich harvest of facts from such desertly stations.

Observations on the Solar Protuberances during the Last Three Months of 1873; Results from use of Gratings Instead of Prisms in Spectral Observation of Protuberances.—P. Secchi.—The solar activity was little. Half-a-dozen spiral spots were observed. The rotation was verified, but not more than two days, after which it disappeared. The co-existence of spots with eruptions at the sun's border was verified eighty-nine times; only eight times were spots seen at the border without eruption. The reversed lines observed in eruptions were the line intermediate between B and C, the lines D', D'', the lines *b* of magnesium, a large number of the lines of iron, the ordinary lines of hydrogen, and the line D_3. The spiral movement, rare in spots, was several times noticed in protuberances, and not unfrequently a rotation about a horizontal axis. An important observation on Jan. 23, 1874, is given by the author in detail (with figures). "I shall not pass the limit of facts in saying that this spot was the product of an eruption which commenced in a tumultuous manner in the morning, formed in developing-jets whose summits we saw, and that the matter of the eruption falling back to the sun, and being interposed between the observer and the photosphere produced the spot. This observation confirms our theory, and throws much light on the phenomenon." P. Secchi speaks in high terms of the advantages from use of some interference gratings given him by Mr. Rutherford when in Rome.

Refraction of Gases.—M. Mascart.—The author describes an ingenious method of measuring this. The refraction of gases being very weak, at least in the conditions in which it is possible to operate, the refractive power $n^2 - 1$ is sensibly double the difference $n - 1$, or excess of refraction. He finds that, at constant temperature, the excess of refraction of a gas is nearly proportional to the density. He also gives a table of the values obtained for several gases with variations of temperature not exceeding 40°. It appears that the refractive power diminishes, in general, more rapidly than the density.

Geometrical Demonstration of Some Theorems by means of the Consideration of a Rotation Infinitely Small.—M. Mannheim.

Apparent Orbit and Period of Revolution of the Double Star η of the Crown.—M. Flammarion.

Mode of Production of Several Induction Currents.—M. Gaiffe.—The author made a series of experiments suggested by some curious phenomena observed in the gas-lighting by electrical method of the National Assembly hall.

Influence of Albumenoid Substances in Electrical Phenomena.—M. Onimus.—M. Becquerel has shown that when two heterogeneous liquids are separated by an organic membrane or by a capillary space, they give an electric current capable of producing chemical and mechanical effects, reduction of metals, and double decompositions, &c. The author finds that the interposition of a layer of albumenoid matter (white of egg, albumen of blood) has the same electro-chemical results. Thus, with solutions of sulphate of copper and of oxalate of potash separated in a tube by albumenoid substance, beautiful blue crystals of oxalate of copper and potash are obtained. The phenomena, he points out, may throw light on the formation of phosphate of lime in animals. This is obtained in the U tube when the two liquids used are phosphate of soda and nitrate of lime, or chloride of calcium. Again, M. Cl. Bernard has shown that all salts of iron passing through the system are transformed by way of deoxidation or passage to the state of proto-salt. Now the same transformation occurs when perchloride of iron and red prussiate of potash are in contact with albumen in the tube. The perchloride is changed into the protochloride.

New Researches on the Physiological Exhaustion of Beer-Yeast, and Remarks on a Recent Communication by M. Schützenberger on the Same Subject.—M. A. Béchamp.—A "reclamation of priority;" the author maintaining that the recent paper of M. Schützenberger confirmed his previous results.

Action of Chloral on Albumen.—M. H. Byasson.—The author controverts the view of M. Personne that chloral enters into combination with albumen. He maintains that the urine of persons who have taken chloral hydrate has only a very slight reducing action upon cupro-potassic liquid.

Bulletin de la Societe Francaise de Photographie,
No 12. 1873.

At the meeting of the Society, December 5, M. Sutton sent four proofs obtained by one of the procedures described in his "Theoretical and Practical Studies" now in course of publication in the *Bulletin*. The collodion was his ordinary bromo-iodised kind, containing 1 grm. bromide of cadmium to 140 c.c. of collodion. The bath was 7 per cent. The plates were then washed to remove every trace of free nitrate of silver, and covered with a hygroscopic coating composed of—Albumen, 1 vol.; glycerine, 1 vol.; water, 2 vols. They were never dried; prepared in the morning, and developed in the evening with pyrogallic acid to which some drops of nitrate of silver had been added.

M. Buyron, of Lyon, communicated a new mode of preparing collodio-bromised emulsion. He seeks to imitate in the preparation of the emulsion that which takes place when a collodionised plate is sensitised. He prepares a bromised collodion as follows:—

Alcohol at 40° ..	35 cc.
Ether	35 "
Gun-cotton	1 grm.
Bromide of cadmium	3·5 grms.

After standing for eight days it is poured into a wide-mouthed flask, and evaporated with agitation so that no pellicle may form on the surface. The evaporation is continued till the mass ceases to flow, and does not allow any liquid to drain out of it. On the other hand, 3·5 grms. of nitrate of silver are dissolved in 30 c.c. of alcohol at 36°. The filtered solution is placed into a flask large enough to contain, in addition, the jelly just obtained, which is broken up with a bone spatula, and added to the silver solution in small portions. The mixture is left to react for two or three days. At the end of this time the bromide of cadmium is completely transformed into bromide of silver. The fragments are then again broken up, the alcohol is decanted off, and replaced by 30 c.c. of fresh alcohol at 36°, which is allowed to remain for two or three days longer. This alcohol is then poured off and added to the former. The gelatinous mass remaining is mixed with—

Alcohol at 40°	40 c.c.
Ether	60 "
Gun-cotton	0·2 gr.

and shaken up till completely dissolved. After standing five or six hours nine-tenths are decanted off and preserved for use.

M. Monckhoven has published in the *Rivista Fotografica* a paper on the collodion most suitable for landscapes. He considers an iodised collodion preferable to a bromised.

Two New Preservative Substances Employed in the Dry Collodion Process.—M. de Saint Florent.—These two substances are ratanhia and Sydenham's laudanum. Ratanhia is an extract from the root of *Krameria triandra*, a polygalaceous plant, growing in the Antilles and in Peru. It is rich in tannin, and when employed in the proportion of 10 parts of the aqueous extract to 100 of water, and 10 to 20 of alcohol, it forms an excellent preservative. It is best used with a strongly bromised collodion. The laudanum gives still better results; the proofs obtained with it are very harmonious, and present remarkable gradations of tints. Its properties seem due to the presence of morphia.

Development of Carbon Proofs by the Aid of Metallic Plates.—M. Gobert.

Theoretical and Practical Studies.—M. Th. Sutton.—A continuation of the series of papers commenced by this author some time back.

Reimann's Farber Zeitung, No. 6, 1874.

This number contains a continuation of the article on dyeing vat-blues by G. Leuchs; a receipt for an aniline-violet on cloth or flannel, in which 2 lbs. sulphate of magnesia and ¼ lb. sulphuric acid are recommended to 10 lbs. of the goods. The same directions, with merely an alteration in the aniline colour, are given for an aniline-blue, with which sulphuric acid certainly agrees much better than with a methyl-violet. Next follows a continuation of the paper on the manufacture and dyeing of shoddy.

New Red Colour.—The *Musterzeitung* professes to have received a "new red colouring matter from a firm in New York." A swatch dyed with this "new colour" fell into the hands of Dr. Reimann, and on examination proved to be dyed with cochineal!

Signification of Colours—The *Moniteur de la Teinture* inserts an article by the French poet Gozlan, in which he associates all emotions of the soul with different colours. Thus compassion is light blue; resignation, pearl-grey; joy, apple-green; satisfaction, the colour of caffé au lait, &c.

Clearing (Avivage) of Turkey-Reds Obtained with Artificial Alizarin.—Dr. Armand Müller.—If eau de Javelle or the hypochlorites of magnesia and tin are employed, and the goods afterwards passed through "sours," consisting of a mixture of sulphuric and nitric acid, the red becomes more fiery and inclines more to an orange.

Aniline-Blue on Garments (Cotton Warps).—Work in a clear decoction of 2 lbs. sumach, in which ¼ lb. of Marseilles soap has been dissolved; let them lie in the liquid over-night, lift, and soak for six hours in red liquor at 2° B. Aniline-blue, of as green a shade as possible, is dissolved in water, allowed to cool, the solution filtered and used for the dye-beck, with the addition of one-tenth of the spent red liquor. Begin to dye cold, raise the temperature slowly, and finish at a boil. Lift, rinse, pass through gum tragacanth, and finish.

Rosenstiehl has patented a machine for straining printers' colours by the pressure of the atmosphere.

MISCELLANEOUS.

Metropolis Gas Acts.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently submitted his quarterly report to the Corporation of London and the Metropolitan Board of Works on the quality of the gas supplied during the months of January, February, and March by the Chartered, the Imperial, and the South Metropolitan Gas Companies; from which it appears that the average illuminating power of the Chartered gas at the different testing-places has been as follows:—Beckton, 17·31 standard sperm candles; Cannon Street, City, 17·01 candles; and Friendly Place, Mile End, 17·38. The average power of the Imperial gas has been 16·81 candles at Carlyle Square, Chelsea; 16·04 candles at Camden Street, Camden Town; and 16·61 candles at Graham Road, Dalston; while that of the South Metropolitan gas at Hill Street, Peckham, has been 16·61 candles. These results are above the requirements of the several Acts of Parliament. With respect to purity Dr. Letheby reports that the gas of all the Companies has been constantly free from sulphuretted hydrogen, and that the average amounts of sulphur in other form than this has been 13·67 grains per 100 cubic feet of the common gas at Beckton, 14 grains per 100 feet at Cannon Street, 11·02 grains at Friendly Place, 23·54 grains at Millbank Street, 18·67 grains at Ladbroke Grove, 17·95 grains at Carlyle Square, 20·68 at Camden Street, 19·86 grains at Graham Road, and 26·93 grains at Hill Street, Peckham. The proportion of sulphur has been in excess of the prescribed quantity on one occasion at Beckton, on one occasion at Carlyle Square, and on nine occasions in the South Metropolitan gas at Hill Street, Peckham. Most of these have been the subjects of appeal under the provisions of the Acts of Parliament, and the Chief Gas Examiner, having enquired into them, has certified that they have arisen from unavoidable and accidental causes. The proportion of ammonia in the gas at all the testing-places but one has never exceeded the prescribed quantity of 2·5 grains per 100 cubic feet of gas. At Ladbroke Grove, however, the cannel gas of the Chartered Company has on 19 occasions contained an excess of this impurity. The illuminating power of the cannel gas of the Chartered Company has averaged 21·45 candles at Millbank Street and 21·50 candles at Ladbroke Grove.

Glasgow Veterinary College.—Dr. R. Carter Moffat, Professor of Chemistry, has left England to carry out an extensive series of experiments in Southern Italy. He proceeds to the great alpine district of the Santa Liberata and Valley Romana, where enormous deposits of bitumen, sulphur, and lignite exist. We wish him a successful journey.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of gas for heating and illuminating and in the utilisation of residual products of the said manufacture John Hinks, manufacturer, and Henry Holland, tool-maker, Birmingham. June 9, 1873.—No. 2047. In manufacturing gas according to this invention, caoutchouc or other solid hydrocarbon is dissolved in benzoline or other volatile liquid hydrocarbon and caustic alkali, or alkaline earth and water are added. This mixture is heated in a generator, and the gas evolved conducted first into a heated receiver, and afterwards into a chamber containing trays filled with benzoline or other volatile liquid hydrocarbon. From this chamber the gas enters a receiver, in which it is mixed with about three times its volume of atmospheric air. When the gas is about to be used, it is passed through a chamber containing trays of liquid volatile hydrocarbon into the delivery-pipes. The oily liquid condensed in the pipes and receivers is purified with lime or otherwise, and may be burned in lamps used for burning light oils.

An improved mode of treating sewage- and other contaminated waters. John Leigh, Manchester. June 11, 1873.—No. 2071. For the purification of sewage- and other contaminated waters, there is added thereto, in suitable vessels with agitation, a solution of an earthy salt, and afterwards a solution of silicate of soda or of potass, whereby a precipitation or subsidence of the suspended matters in the sewage- or other waters is produced. Of the earthy salts, it is preferred to use a solution of alum or of sulphate of alumina, of sulphate or of muriate of magnesia, or of muriate of lime. Should the sewage- or other water, after being thus treated, contain any gelatinous or albuminous matters in solution, or afford evidence of other organic matter in solution, it is preferred to add a small quantity of a solution of tannin or of some solution containing tannin thereto.

Improvements in the production of chromic acid, compounds containing chromic acid, and certain other compounds of chromium. Desmond Gerald Fitz-Gerald, electrician, 6, Loughborough Road North, Surrey, and Bernard Charles Molloy, barrister-at-law, 1, Elm Court, Temple, Middlesex. June 13, 1873.—No. 2102. This Provisional Specification describes a process for obtaining chromic acid from bichromate of potash. The Provisional Specification also describes various chemical processes relating to the production of compounds of chromium.

Improvements in the construction and working of voltaic batteries. Desmond Gerald Fitz-Gerald, electrician, 6, Loughborough Road North, Surrey, and Bernard Charles Molloy, barrister-at-law, 1, Elm Court, Temple Middlesex. June 13, 1873.—No. 2103. This Provisional Specification describes a voltaic couple in which the negative element divides the cell into two compartments. One compartment contains the positive element, and the other a solution capable of oxidising nascent hydrogen. The Provisional Specification also describes other improvements in voltaic batteries.

Improvements in the manufacture of manure. Edward Charles Hamilton, Camp House, Colchester, Essex. June 14, 1873.—No. 2114. The object of this invention is to manufacture manure in a dry powdered condition from fish, more especially from the Uraster Rubens, commonly called a five-finger, or from star-fish. The fish are first pulped, then dried, and afterwards reduced to powder.

Improvements in the manufacture of cements, plastic and pulverised compounds, combined with chemical and other materials, suitable for being employed in the production of plain and ornamental slabs, moulded and other objects and surfaces, architectural concrete and other structures to which such cements and compounds are applicable, and in the means and apparatus employed in such manufacture; also in treating surfaces, objects, and structures preparatory to applying such cements or compounds or other cementitious materials thereto. Edwin Robbins, designer and modeller, Figtree House, Wedmore Street, Holloway, Middlesex. June 16, 1873.—No. 2116. According to this invention, cement and composition are made by pulverising crude half-burnt or burnt carbonate of lime, baryta, strontia, magnesia, zinc, or any other suitable carbonate separately or combined with each other, or combined with other materials of any description, calcareous or argillaceous. In combination with the above, every description of material—animal vegetable, or mineral—is employed. For exampl·, as one illustration, sand, gravel, silex, stone dust, glass, marl, clay, lime, or any other such material is submitted to a solution of silicate of soda, potash, soluble silicate, gum, glue, or any of the animal, vegetable, or mineral gums in any convenient form or rotation, separately or combined. When sufficiently dry or concentrated, it is then ready for use. The carbonate of lime is mixed with dilute muriatic acid. After standing a sufficient time, they are mixed together with the prepared gritty or other materials in proportions varying from 1 part of lime to 4 parts of sand, or 1 part of lime to 40 or 50 parts of sand, according to the density, quantity, and proportions relatively of the silicate, gum, glue, and gelatin; bitumen, or any other animal, vegetable, or mineral gums are applied in any convenient form.

An improvement in the preparation of spirits, wines, and other fermented liquors. David Ker, William Street, Lowndes Square, Middlesex. June 16, 1873.—No. 2123. The object of this invention is, first, to soften new and fiery spirits and to improve their flavour, while at the same time they are rendered comparatively innocuous to the coats of the stomach; and, secondly, to preserve light wines, such as clarets, and other fermented liquors from turning acid. These results I attain by combining with such liquids the substance commonly known as glycerin.

A new or improved vulcanisable waterproof gum, and process for producing the same. Benjamin Joseph Barnard Mills, patent agent, of the firm of Harris and Mills, 35, Southampton Buildings, Middlesex. (A communication from Daniel Martin Lamb, machinist, Strathroy, Middlesex, Ontario, Canada). June 17, 1873.—No. 2126. The subject of this invention is a vulcanisable waterproof gum, produced from the inspissated juice of plants of the asclepias or milk-weed family, or other plants possessing like properties, or from flax or other analogous seeds.

An improvement in the manufacture of hydraulic cements. Alexander Bennett McGrigor, solicitor, Glasgow, Lanark, N.B. (A communication from James Moeller Robertson, architect, Melbourne, Victoria). June 19, 1873.—No. 2147. This invention substantially consists in making a strong hydraulic cement by the mixing of one or other of the known simple infusorial limestones of the oolitic and other geological periods in a powdered state, with a proportion of any of the nearest well-known simple basalts of the basaltic formation and periods, both in their natural state, the proportion of the two to be mixed being easily found by trials depending mainly on the nature of the basalt used, which the inventor has found by examination contains the necessary ingredients for making such a water-cement, without the separation of substances thereto or from, as is necessary in the ordinary processes of making these cements from various limestones, chalks, and clays. The inventor has thus found that these substances do not materially vary in their composition, so that he is enabled to make a portland hydraulic cement by their mixture, which he claims as his invention, substantially as described.

NOTES AND QUERIES.

Determination and Estimation of Anthracen.—Will some reader kindly answer the following:—What is the most simple and accurate method of determining and estimating the quality of anthracen after being pressed, washed, and re-pressed? What work on chemistry gives most information relative to coal-tar products.—Student.

Estimation of Nitrogen.—(Reply to "Student.")—"T.," in addition to advising the use of the troublesome method of Dumas for estimating the total nitrogen, overlooks the fact that Varrentrap and Will's method yields some of the nitrogen of the nitrate as ammonia, especially if some kinds of organic matter be present (*Chem Soc. Journ.*, [2], xi., 1161). In fact, Fresenius, who is referred to for the details, directs that the total nitrogen in manures, containing it in the three forms, should be estimated by Varrentrap and Will's method. Fresenius then advises the use of Schlösing's methods for estimating the ammonia and the nitric acid. E. Hunter assumes that the nitrogenous organic matter will be insoluble in water, which is, by implication, denied by Fresenius, who, in recommending Schlösing's method of estimating nitric acid in manures, says that it is particularly applicable in the presence of organic matter, from which "the [aqueous] solution will scarcely ever be free." If "Student" simply desires to know the total nitrogen present in the three forms I should recommend the method given by me in the Chemical News, vol. xxv., page 205.—B. J. Grosjean.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

4882. (Professor Way.) Sewage contains so large a quantity of carbonic acid that when you put lime in it carbonate of lime is formed. The object is to produce a precipitate, which, in going down, shall take those flocculent matters.

4901. Do you know what the plan which is pursued at Leicester is?—Yes; I have seen it.

4902. Is that a successful experiment?—It has been a tremendous failure as a money speculation.

4903. Is that undertaken by the town?—No; it was undertaken by a company at a cost, I think, of something like £60,000. They made large quantities of solid manure, by precipitation by lime, and they succeeded in selling some of it at first, but, generally speaking, they sold it to fresh customers every time; that is to say, a man used it, and then would not buy any more; and now they can only sell it at 2s. per ton.

4914. (To the same.) Yot state that clay is the best deodoriser; have you ever turned your attention, or do you know much of Bagshot Heath, and Woking, and those districts?—I know that district very well.

4920. In all our analyses of the sewage water we have found a quantity of insoluble matter of the nature of clay amongst the other insoluble matters, and I believe that at Edinburgh now the soil has to a great extent become a different soil from what it originally was; by that means it would be perfectly practicable to pump a little suspended clay on with every gallon of water, if you were doing it on a lage scale, and it would be only a trifling increase of expense, because clay, when once suspended in water, subsides with great difficulty.

4922. (To the same.) As the sewage progressed it would require clay for the purpose of deodorisation?—Yes.

4962. I say that if a man owes me the value of an ounce of gold, £4 15s., and if he comes and gives me a ton of quartz, and says "there is an ounce of gold in this ton of quartz," it is not paying me. That is precisely the condition of the sewage.

5015. (To Mr. Congreve.) Do you mean to say that greater crops are not procured by means of the application of sewage?—Greater crops are procured, but they are of a much worse quality, the land grows a greater quantity of grass, but that grass is not of the same value as the grass that grew there before.

5025. What is your opinion of the large quantities of sewage that Mr. Lawes has applied; has it made the land worse?—I believe it has.

5026. Since Mr. Lawes has applied sewage the land is not nearly so good as when it was in Mr. Walker's hands?—Certainly.

5027. Do you mean to say, also, it was in worse condition when Mr. Walker gave it up to Mr. Lawes than when Mr. Walker received it?—No; because one piece had not been sewaged before Mr. Lawes took it in hand, and the result ought not to go forth as the result of the application of sewage; that land was thoroughly drained and manured before he began, and it would have produced much better crops before the sewage was applied to it. Therefore Mr. Lawes's results are complicated results, and the results of good management previously.

5028. (To the same.) Was not the land sewaged before Mr. Lawes took it?—Not that one piece.

5030. Is the most sewaged piece the worst of the three?—I should say it is, decidedly.

5045. Are you of opinion that the application of sewage would be actually injurious instead of being beneficial to the land?—Some of the land at Rugby was good feeding land previous to the application of sewage, and the sewage being applied to that land certainly deprived it of its feeding powers; feeding land is at present the most valuable land that we have.

5047. If applied to fallow land would it not grow corn well?—No; you get no corn from it; you get a large quantity of straw and coarse corn, but there is scarcely any wheat from it.

5053. Do you consider that it is a failure?—I do not know at all, it is such a varied question. Mr. Lawes shows that sewage will produce a very great quantity of grass, but he does not say anything of the quality of the grass.

5056. (To the same.) Does it destroy the finer grasses?—Yes; it destroys the finer grasses and encourages the coarser ones. As an instance of that I may say that the hay from a field which, before the sewage was applied was one of the best fields in the neighbourhood, a little while ago was worthless.

5068. Do you consider the land at Rugby to be over-tilled by the sewage?—The finer grasses have been destroyed and the coarser ones stimulated.

5082. How often was it applied in the year?—Four or five times.

5083. Did it destroy the fine grasses?—Yes, decidedly.

MEETINGS FOR THE WEEK.

Monday, 27.—Medical, 8.
— Society of Arts, 8. Cantor Lectures.
— London Institution, 4.
— Geographical, 8.30.
— Philosophical Club, 6. Anniversary.
Tuesday, 28.—Civil Engineers, 8.
— Anthropological, 8.
— Royal Institution, 3. Prof. Rutherford, "The Nervous System."
— Society of Arts, 8. Col. J. C. Gawler, "On the History, Progress, and Prospects of South Africa."
Wednesday, 29.—London Institution, 12 a.m. Anniversary.
— Society of Arts, 8.
— Zoological, 1 p.m. Anniversary.
— Geological, 8.
Thursday, 30.—Royal Institution, 3. Mr. W. N. Hartley, "On the Atmosphere."
— Royal, 8.30.
— Royal Society Club, 6.
Friday, May 1.—Royal Institution, 2. Annual Meeting.
— Royal Institution, 9. Prof. Rolleston, "Early Inhabitants of North of England."
— Society of Arts, 8. Mr. H. G. Kennedy, "Ruins of Cambodia and the Antiquities of Indo-China."
— Geologists' Association, 8.
Saturday, 2.—Royal Institution, 3. Prof. Seeley, "Age of French Revolution."

TO CORRESPONDENTS.

H. Cant.—In a few weeks.

K. I. K.—Calc-spar and Iceland-spar are the same thing. They can be obtained from any dealer in minerals.

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CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,
Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 169.)

II. Tea (*continued*).

Since the first part of this article was printed, I have submitted the same set of samples of purposely adulterated tea (described on page 168) to another tea-taster of great experience, who formed the following opinions as to their purity:—

No. 1.—Very poor; contained many exhausted leaves. Ranked 5th.

No. 2.—Passed pure. Ranked 1st.

No. 3.—Would have been the best, but lacks strength, and is therefore suggestive of exhausted leaves. Ranked 3rd.

No. 4.—Not pure, but very slightly adulterated by exhausted leaves. Ranked 4th.

No. 5.—Passed pure, and ranked 2nd.

Estimation of Tannin, &c., by Lead.—Five grammes of lead acetate are dissolved in water and diluted to 1 litre, and the solution filtered after standing. The indicator is made by dissolving 5 milligrammes of pure potassium ferricyanide in 5 c.c. of water, and adding an equal bulk of strong ammonia solution. One drop of this test will detect 0·001 milligrm. of tannin, or 1 milligrm. dissolved in 100 c.c. of water.

The precipitating power of the lead solution is ascertained by diluting 10 c.c. of it to about 100 c.c. with boiling water, and adding to it, from a burette, a solution of 0·1 grm. of pure tannin in 100 c.c. of water. After adding 10 c.c. of the latter solution, about 1 c.c. of the liquid is withdrawn with a pipette and passed through a small filter, the drops being allowed to fall on to spots of the indicating solution previously placed on a porcelain slab. If no pink colouration is observed, another small addition of the tannin solution is made, a small portion of the liquid filtered, and added to the indicator as before, the process being repeated until a pink colour is observed. The greatest delicacy is obtained when the drops of liquid from the funnel are allowed to fall directly on to the spots of indicator, instead of observing the point of junction of the liquids.

The reaction being complete, a second estimation is made, and in this case almost the full volume of tannin solution can be added at once.

It is necessary to use the purest tannin for the purpose, as a serious error may otherwise occur, some samples of commercial tannin having little more than half the precipitating power of the best.

Exactly the same process is employed for estimating the tannin in tea, the decoction being substituted for the standard tannin solution and added to the lead solution as before.

The solution of tea is prepared by boiling 2 grms. of the finely-powdered sample with about 80 c.c. of water for half an hour. The decoction is strained through fine muslin, the particles of leaf returned to the flask, and the boiling resumed for an hour with the same quantity of water as before. The process is repeated till no more colouring matter is extracted. The whole of the solution is set aside, to allow any particles that may have passed through the muslin to subside when the liquid is decanted from the sediment, the last portions passed through a filter, and the whole decoction made up to 250 c.c. This diluted solution is ready for use in the burette, the remainder of the process only occupying a few minutes.

The volume of tannin, or tea solution, it is necessary to add to 100 c.c. of pure water, in order that a drop may give the pink reaction with the ferricyanide is subtracted from the total amount run from the burette.

If the solutions are made of the strength here described, 10 c.c. of the lead solution will precipitate about 10 milligrms. of pure gallotannic acid, and therefore the volume of tea solution added contains 0·01 grm. of tannin.

If all the weights and volumes above mentioned are observed, 125, divided by the number of c.c. of tea solution used, will give the percentage of tannin, &c., in the sample.

We have ascertained that prolonged boiling does not affect the precipitating power of the tea, and solutions of the same sample prepared on different occasions have given absolutely concordant or closely agreeing results. The percentage of tannin in tea can be ascertained by this process to within 0·2 per cent.

The results obtained by this method agree fairly with those recently obtained by Mr. Bell by the gelatin process, as will be seen from the following figures:—

Tannin in Genuine Black Tea.

	By Gelatin. (Bell.) Per cent.	By Lead. (Allen.) Per cent.
Highest amount	12·00	11·6
Lowest amount	9·50	8·5
Average of 8 samples ..	10·97	—
Average of 28 samples ..	—	10·0

Even after infusion tea-leaves still retain a sensible quantity of tannin, which varies from 1 to 4 per cent, according to the extent of the previous treatment. The usual amount is about 3 per cent. Taking the tannin in fresh tea at 10 per cent, and in exhausted leaves at 2 per cent, the extent to which a sample is adulterated would be found approximately by the following equation, in which E is the percentage of exhausted leaves, and T the percentage of tannin found:—

$$E = \frac{(10 - T)\,100}{8}$$

We have not examined many green teas by the lead method. The tannin found in genuine specimens varies considerably, 20 per cent being about the usual amount. The estimation is of less importance than with black tea, as green tea is very unlikely to be adulterated either with exhausted leaves or foreign tannin matters.

Insoluble Matter.—When tea in its commercial condition is boiled repeatedly in fresh quantities of water till the liquid no longer becomes coloured, the residual leaves, when thoroughly dried, weigh about 50 per cent of the original tea, if green, and about 60 per cent if black. A very large number of estimations of insoluble matter have been recorded, and in no case has a genuine tea yielded a higher percentage than 60·12, which was obtained by Mr. J. Bell from an inferior congou tea. In the accompanying tables I give a number of analyses of genuine teas, from which it is evident that the proportion of insoluble matter is very constant, even in teas of very different qualities.

Having noticed that in broken teas the insoluble matter was sensibly less than in unbroken, we tried the effect of exhaustion by repeated boiling with water on various genuine teas previously reduced to powder. By this method the percentage of insoluble residue is still more constant, but about 8 or 10 per cent lower in each case than is obtained by treatment of the whole leaves. Thus genuine green teas gave an average of 42·0 per cent, the highest amount being 45·0 per cent, and the lowest 39·0 per cent. In black teas the lowest gave 46·7 per cent, and the highest 53·6 per cent, the average of thirteen samples being 49·0 per cent.

It is impossible to insist too strongly on the importance of estimating the insoluble matter on the *powdered* tea, not on the whole leaves, for not only is the soluble portion more readily and completely extracted, but the serious error involved in the examination of broken teas is avoided, and the results obtained from such samples can be fairly compared with the rest.

The insoluble matter is most conveniently estimated by drying the residue left after filtration of the tannin solution at about 120° C. till the weight is constant. When the process is repeated on the same tea, the results agree extremely closely with the previous estimation, rarely showing a difference of 0·5 per cent.

The estimation of insoluble matter is of great importance as a means of forming an opinion as to the presence or absence of exhausted leaves.

The percentage of insoluble matter contained in previously infused black tea leaves, after being air dried, varies from 78 to 85 per cent. These results are upon the whole leaves. When the estimation is made on the previously pounded tea the insoluble matter varies between 72 and 75 per cent.

Gum.—It is occasionally desirable to estimate the percentage of gum in tea. Infusion in water of course removes most of the gum. Caper teas and exhausted leaves often contain excess, owing to an addition of gum during their preparation. The gum is determined by evaporating the aqueous decoction of the tea almost to an extract, treating the residue with methylated spirit, and filtering and washing with spirit. The gum is rinsed off the filter with hot water, and the solution evaporated at a steam-heat, and the residue weighed, ignited, and weighed again. The loss represents the gum. If the ignition is omitted the results are too high, owing to the presence of mineral matter.

Soluble Ash.—The percentage of ash soluble in water is also a valuable independent indication of the presence of exhausted and foreign leaves. In the following table I give the percentage of soluble ash contained in a number of samples of genuine tea in exhausted tea-leaves, and in the dried leaves of various other plants:—

	Total Ash.	Soluble Ash.	Authority.
Coffee leaves	10·32	3·77	A. H. Allen.
Beech	4·52	2·00	J. A. Wanklyn.
Bramble	4·53	1·84	,, ,,
Raspberry	7·84	1·72	,, ,,
Hawthorn	8·05	3·78	,, ,,
Willow	9·34	4·16	,, ,,
Plum	9·90	5·66	,, ,,
Elder	10·67	3·19	,, ,,
Gooseberry	13·50	7·83	,, ,,
Common tea	5·92	3·55	,, ,,
Paraguay tea	6·28	4·22	,, ,,
Average of seven teas	5·75	—	,, ,,
Average of nine teas of commerce	5·66	3·00	A. S. Wilson.
*Horniman's pure black	5·30	3·50	A. H. Allen.
* ,, ,, green	5·60	3·80	,, ,,
*"Ambrosial" black tea	5·60	3·40	,, ,,
*Genuine black at 2s. 6d.	5·60	3·09	,, ,,
* ,, ,, ,,	5·70	3·28	,, ,,
* ,, ,, ,,	6·02	3·26	,, ,,
* ,, ,, ,,	6·34	3·20	,, ,,
* ,, ,, ,,	6·10	3·96	,, ,,
* ,, ,, ,,	5·75	3·06	,, ,,
* ,, ,, at 3s.	5·50	3·55	,, ,,
Broken leaf, with stalks	5·40	2·80	,, ,,
Caper (containing 4·8 siliceous matter) ..	11·40	1·50	,, ,,
Mixed dry exhausted leaves from various teas	4·30	0·52	,, ,,

The soluble ash is determined by evaporating the aqueous solution of the ash, and *gently* igniting the residue, which must be cooled under a desiccator. The mean total ash of the teas marked with an asterisk comes to 5·75 (the same as Wanklyn's mean), and the soluble ash to 3·34, and it will be seen that the latter constituent is scarcely ever below 3·00, while exhausted tea-leaves contain only 4·3 of total and 0·52 of soluble ash. When no foreign leaves are present we are therefore fully justified in calculating the probable proportion of exhausted leaves by the following formula, in which E is the percentage of exhausted leaves, and S the percentage of soluble ash:—

$$E = (6 - 2S)20.$$

Of course the result can only be considered as an approximation to the truth, but when the proportions of soluble ash, tannin, and insoluble matter agree in proving the presence of previously exhausted leaves, a very fair conclusion can be arrived at as to the extent to which the adulteration had been practised.

(To be continued.)

ON COMMERCIAL ANALYSES.*

By E. C. C. STANFORD, F.C.S.

The attainment of accuracy in the methods employed in the valuation of commercial products is becoming daily more important. It is not my intention in this paper to refer to adulterations strictly so-called, but merely to the valuation of the large class of chemical products sold only by analysis. The number of samples passing through the hands of the analytical chemists of Glasgow alone must be enormous; and, although I can bear strong testimony to the remarkable accuracy with which these analyses generally are performed, there are often disputes with other chemists employing different methods, and then we feel the want of certain standard processes of sufficient authority to appeal to.

Chemists who do not employ exactly the same methods almost always differ in reporting the strength of a given sample, especially where there are several bases and acids present, and particularly if the separation of these is difficult. But even those who may happen to employ the same method in these cases, and may attain the same results, often differ so widely in the statement of those results, that their analytical figures look like those of different substances. The custom with some analysts of making their figures up to 100, and thus giving the analysis the *appearance* of being complete, and *perfectly* accurate is highly to be deprecated. The analysis should be always given as the figures come out, and, if the analyst is in any doubt as to the way in which the acids and bases are combined, the amounts of these should also be stated separately.

Now that all large chemical works are obliged, for their own guidance and protection, to have a thorough analysis of all they consume and produce, it is not sufficient to know that a carbonate of potash or soda contains a certain percentage of alkali; we must know also which alkali it is, and what acids it is combined with.

Here, again, the want of uniformity produces confusion. I shall only select a few simple examples of differences in processes, and then consider the effect of different statements of results, and afterwards suggest what appears to me to be the only remedy. I shall allude only in this paper to superphosphates and potash and soda salts.

Superphosphates.—There are few products more in dispute than those containing phosphates of lime. I heard of a case some time ago in which samples of a cargo of coprolites, guaranteed 62 to 63 per cent, were drawn and sent to four chemists, all eminent. One made the strength 56 per cent, another 57 per cent, another 58 per cent, and the other 62 per cent—the latter being right. Putting the value at £3 10s. per ton, or, say, 1s. 2d. per unit, there was a difference in value of 7s. per ton between the highest and lowest, and any broker buying by the latter and selling by the former would make a profit of £35 on the 100 ton cargo. This would be about 10 per cent, a pretty good brokerage, and enough to induce him to retain a "low chemist" permanently on the establishment. As there are computed to be about 200,000 tons of mineral phosphates raised in Great Britain alone, this difference would be equal to about £70,000 per annum—an ample margin for anyone who likes to trade on scientific weakness.

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* A Paper read before the Glasgow Philosophical Society, Chemical Section.

Mr. James Napier in a paper read before this Society in 1870,* speaking from an experience of over two hundred analyses of phosphate, says that the discrepancies between different chemists was generally from 2 to 3 per cent, and sometimes 5 per cent. He mentions one case of a sample of dissolved bone-ash sent to four different analysts, whose results varied from 41 to 47 per cent,—44 per cent being correct. He also mentions one analysis of bone-ash in which 9·5 per cent of phosphate of magnesia was reported as an ingredient. Where iron and alumina are present, the differences in the estimation of the insoluble phosphates are often considerable. One well-known chemist reported a sample of superphosphates from coprolites after four determinations, of which all gave uniform results of soluble phosphates, but all gave different results in the insoluble; the presence of alumina was the cause of these discrepancies.

There are so many processes in use for the estimation of phosphoric acid in phosphatic materials, and the discrepancies, particularly in coprolites and mineral phosphates, and in the manures made from these, are very considerable.

Some chemists still cling to the inaccurate method of simply precipitating the tribasic phosphate of lime by ammonia, and the precipitate may contain, in addition, everything precipitable by ammonia; it is generally, therefore, too high. Others adopt Fresenius's magnesia method, where, the lime being precipitated by oxalate of ammonia, the iron and alumina are held in solution by citric acid; the phosphates are weighed as ammonio-phosphate of magnesia. This process gives results a little too low. At a convocation of chemists at Magdeburg, held three years ago, it was agreed that, when this process was adopted, it could be made sufficiently accurate by the addition of 0·1 to every 5 per cent of tribasic phosphate of lime found. The convocation, however, agreed that the best, although the most tedious method, was by precipitation as phospho-molybdate of ammonia, and subsequent conversion into ammonio-magnesian phosphate, and, finally, by ignition into di-magnesian phosphate. I quite agree with Warington that the phosphate should always be acted on by cold water in the first instance. The presence of alumina in this solution will, however, produce a precipitate of phosphate of alumina on boiling, and in this case a cold solution will show more soluble phosphates than a boiling solution. In some instances where alumina is not present, it is recommended to precipitate the phosphoric acid as phosphate of uranium. Mr. Ogilvie, in a paper read before this Section in 1872, gives a good process for the general analysis of phosphates containing iron and alumina.†

Potassium Salts.—There is often considerable discrepancy in the total amount of potash reported by different chemists. It is chiefly observed in the comparative results of German and English chemists, and also between the latter and our local chemists. It probably arises from the use of alcohol in addition to platinum chloride, whereby a portion of the soda salt is not unfrequently thrown down and weighed with the potassium salt; others digest with a large excess of strong platinum chloride solution, without alcohol, in which the potassium salt is quite insoluble, while the soda salt is freely dissolved. Alcohol is used only to finally wash the precipitate. In a perfectly pure potash salt free from soda, the former process may give accurate results, but, when soda is present, the differences in the two processes may range from 1 to 2 per cent of potash, and have been known to be sometimes 5 per cent.

It is to be noted that a complete analysis of the mixed salts affords little check on the potash result, as, if the estimate be too high—in the case of muriate, for instance—a portion of the chlorine will have to be withdrawn for it; this would otherwise have been calculated as chloride of sodium, a few per cent of which will thus substitute chloride of potassium, and make up an apparently accurate analysis.

Mr. Tatlock introduced the use of platinum chloride solution instead of alcohol in an excellent paper read before this Society in 1868, and before that time there was considerable difference in the potash results of our local analysts, which have not occurred since that process was published. In our own works, where a large number of potash determinations are made every week, we invariably employ this process, and find it perfectly accurate. Indeed, whenever we examine the same samples as Mr. Tatlock, we find most concordant results, and I know of a case where his accuracy was tested, in a dispute with a German chemist, in a way which he now hears for the first time. A carefully-prepared mixture of pure salts of potash and soda was sent to him, and reported exactly accurate. In the paper referred to, Chalmers and Tatlock show the great importance of using perfectly-pure platinum, and the difficulty of obtaining it; and that ordinary spongy platinum will give a result 2 per cent too high in chloride of potassium. Some other details of manipulation and calculation are given in the paper, which is the best which has yet appeared on the subject, and, if the process is followed as described, I repeat, from long experience, it is rigidly accurate. I speak strongly on this point, because the process was afterwards criticised in the CHEMICAL NEWS by Teschemacher and Smith, in which they kindly attributed all the inaccuracies to the chemists of Glasgow, and all the perfect results to their own process, which involves the use of alcohol and its attendant errors. In this paper the authors convict themselves, as in one of their own experiments, undertaken to test the process, they actually show an error of 1·4 per cent of a potash salt. Now, that may be near enough for London, where there are no potash manufacturers, but it would not do for us. In the salt referred to—nitrate of potash—it would make a difference of 8s. 6d. per ton. And yet in a recent letter in reference to this process, Mr. Teschemacher says—"It fell to our lot to examine the validity of the alarming statements these gentlemen had published, when in a memoir on the same subject, to be found also in the same volume of the CHEMICAL NEWS, we had the satisfaction of proving that the alarm they had raised was utterly groundless, and that they, in fact, had found a mare's nest. In this memoir of ours we, further, were able to render the service to chemical analysis of describing in detail a more perfect and easier mode of determining potash by platinum than had hitherto been employed, a mode which is now generally adopted by analysts, and incorporated in the recent text-books of chemical analysis." And, further, he does not think that I will deem it requisite to pursue my researches on this subject further, when I have read what he calls "this hitherto-unquestioned memoir."

Statement of Results.—If authorities differ in the processes employed, so do they also considerably differ in the statement of results and reports of analytical values. I repeat here, in the first place, that the figures ought never to be made up to 100. It only shows an apparent accuracy to those who do not understand analysis, and may cover a multitude of sins. To the initiated, it shows that the analysis in many cases *cannot* be accurate. I shall refer again to the same substances, superphosphates and potash and soda-salts.

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* Napier, on "The Farmer and the Chemist"—*Proc. Phil. Soc. of Glasgow*, vol. vii., p. 387.

† Ogilvie, "On the Separation of Phosphoric Acid, Ferric Oxide, Alumina, Lime, and Magnesia"—*Proc. Phil. Soc. of Glasgow*, vol. viii., p. 189.

Superphosphates.—The valuation of these important manures is full of confusion. Mr. T. L. Patterson, in a paper read before this Section in 1872,* treated most exhaustively the value of mineral phosphates from what he called a decomposition point of view," and illustrated very clearly the important bearing on the value from the percentage of what Morfit calls "profligate associates." The valuation should bear an inverse proportion to the amount of these. Thus, some mineral phosphates which contain less phosphate of lime may be really more valuable than others which contain more, because it is not combined with "profligate associates." Again, it is obvious that in a very weak manure the chemical value may be far above its actual value in the market, from the large amount of valueless material with which it may be associated. On the other hand, the directors of the various sewage companies assure us that their manures cannot be valued by analysis at all, having some hidden manurial value which only farmers can detect.

I shall not in this paper discuss such a daring assertion; but, taking the ordinary valuations of chemists, it must be admitted that they are apt to adopt certain standards of value without any reference to the actual market value at the time of the various ingredients composing the manure. Hence it often happens that ammonia is valued in a manure at the same rate, though the price of sulphate in the market may vary from £10 to £20 per ton. Then, again, as pointed out by Mr. Napier in the paper before referred to, nitrogen or ammonia, being valued in a manure, no notice is taken of the fact that the nitrogen may exist as shoddy, leather, &c., or as an ammonia salt, the former being actually worth much less than the latter, although the chemical value is put down as the same. Now there should be different values assigned to soluble and insoluble nitrogen, as to soluble and insoluble phosphates. The same remarks apply to phosphates; however these rise or fall in the market, the same arbitrary value is affixed.

Again, except the distinction of soluble and insoluble, no notice is taken of the form in which the phosphate exists. Yet this is a most important point. Most chemists admit that the soluble phosphate of lime is equally valuable, whether it is obtained from animal or mineral phosphate, and most chemists are also agreed that the insoluble phosphate of bones is valuable, while that of mineral phosphate is valueless. Dr. Voelcker, an eminent authority, admits the truth of this, and yet in reporting on the precipitate obtained by the Phosphate Sewage Company (Limited), using Forbes's process, he reports an insoluble phosphate as containing 28·52 per cent of phosphoric acid; now this phosphoric acid, according to his own showing, must consist principally of phosphate of iron and alumina, highly insoluble phosphates, and yet he reports the manure as "equivalent to 62 per cent of tribasic phosphate of lime," and that "it should command a ready sale at £7 7s. per ton."† Forbes, in reporting this result, is evidently a little ashamed of the exaggeration, for he puts the value of the manure at £3 to £5 per ton. It would be interesting to know how much the Phosphate Sewage Company have sold, and at what price. The Company has been in existence a number of years, and from such statements as these the public have been induced to run up its shares to more than five times the amount paid on them. A writer in the Chemical News has three times tried to elicit Dr. Voelcker's explanation of his report, but unsuccessfully; this is much to be regretted, because either the valuation is right or it is wrong, and either Dr. Voelcker has made a mistake and will not admit it, or phosphate of alumina has a manurial value which has not hitherto been assigned to it; and if this be the case, why is it a drug in the market?

With regard to phosphate of lime, we know that much loss is often occasioned to the manufacturer who works mineral phosphates by what is called "going back," or reverting from soluble to comparatively insoluble phosphate of lime; this is now known as "reduced phosphate." There can be little doubt, seeing that all soluble phosphate becomes reduced phosphate when applied to ordinary soils, that this form is quite as valuable to the farmer as the soluble variety. I believe this to be the future form of phosphate, which the farmers will insist on having. It can be made cheaper in proportion, it can be made quite free from "profligate associates" and almost pure, and it is a much more convenient form.

Yet this form of phosphate is not usually valued, and the manufacturers thus lose, while the farmers gain, by chemical analysis. In fact, we have no reliable process by which we can estimate this any more than we can estimate the chemical difference between insoluble animal or mineral phosphate.

This state of things is a discredit to our science. No farmer ought to be able to discover a manurial value which defies the skill of the chemist. I have said enough to show that the analyst should confine his attention to stating the ingredients, and should never be led into their valuation; that is business, not science.

Potassium and Sodium Salts.—Any one who sees a large number of analyses of potash salts containing soda must be struck with the remarkable difference in the statement of results, especially as to the arrangement of the acids and bases. To a certain extent this is arbitrary, but there is no reason why all should not be guided by rules authoritatively fixed. In cases of carbonate of potash the sulphuric acid is often stated as sulphate of soda, and the chlorine as chloride of sodium. I append some instances, taken from the reports of well-known chemists.

Carbonate of Potash.	A.		B.	C.	
Carbonate of potash ..	91·44	With traces of silica and alumina.	80·55	79·99	
Sulphate of potash ..	0·42		—	—	
Sulphate of soda ..	0·34		—	0·71	
Chloride of sodium ..	0·98		3·74	1·72	
Water	6·82		15·71	15·76	
Insoluble matter	traces		—	0·04	silica.
				1·78	carb. soda.
	100·00		100·00	100·00	

All made up to 100; although, if my views are right, all must be wrong, for I hold that the strongest base should go to the strongest acid, and that the sulphuric acid and chlorine should be combined with potassium. For, if we mix solutions of carbonate of potash and chloride of potassium, by boiling down we get chloride of potassium and carbonate of soda.

The following *bona fide* copies of analyses of carbonate are still more extraordinary:—

	D.	E.	F.	
Carbonate of potash ..	75·65	91·60	Potash	58·61
Carbonate of soda.. ..	12·41	5·70	Potassium chloride	6·08
Sulphate of potash ..	8·14	—	Potassium sulphate	3·76
Chloride of sodium ..	2·47	2·80	Sodium chloride ..	3·84
Insoluble	1·28	1·40	Insoluble	0·45
Water	0·60	—	Carbonic acid and water..	25·23
	100·55	100·50		100·00

In addition to the other errors, E is wrong in the add[illegible] or
and F, although made up to 100, is an impossible [illegible] and
for the potash requires 27·37 per cent of c[illegible] strength
alone. er cent, and

Physical conditions will enormously aff. Putting the
certain, however, that we have no au d. per unit, there
ments given above. But there is stil between the highest
chemist puts it in this way, and anot
much better to buy carbonate of pot ical Society, Chemical
and sell it by the analyses of Messrs.

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* Patterson, "On the Part which Ferric and Aluminic Oxides Play of the Manufacture of Superphosphate, and on the Comparative Value n Mineral Phosphates."—*Proc. Phil. Soc. of Glasgow*, vol. viii., p. 191.

† See Chemical News, vol. xxiii., p. 12.

Again, the soda is sometimes reported as hydrate in carbonate of potash, as in the following example:—

	A.
Carbonate of potash	91·30
Sulphate "	2·10
Muriate "	1·75
Hydrate of soda	2·55
Silica	0·90
Water	1·10
Insoluble	0·30
	100·00

I am far from averring that hydrate of soda may not exist in occasional instances, though we have never found it; and its presence is unlikely. The statement makes the carbonate appear to contain the smallest possible amount of soda salts, and hence increases its value.

I append also some published analyses of mixed nitrates of potash and soda:—

	A.	B.		C.		D.
Nitrate of potash..	28·90	30·90		10·3		7·3
Nitrate of soda ..	66·70	62·40		84·5		86·3
Muriate of soda ..	2·00	4·30		1·6		1·2
Sulphate of lime..	0·50	0·50	Sulphate of sodium	0·4	Sulphate of sodium	0·6
Insoluble	0·10	0·10		0·2		0·6
Moisture	1·80	1·80		0·3		4·1
	100·00	100·00		100·0		100·0

Now, in these cases again, all made up to 100, the muriatic acid and (where there is no lime) the sulphuric acid should be combined with the potash, and not with the soda. This has been shown by Henderson, who has proved that nitrate of soda decomposes sulphate of potash.*

In reporting the strength of caustic soda, some analysts still give the "available soda," including carbonate with hydrate. This cannot be right; at least, it is very unfair to manufacturers who show only the hydrate, and have to compete with others who include all the soda; and yet I have heard recently of a buyer even, who will still have his samples reported to include the whole "available soda"

Remedy.—Is there no remedy for these grievances, and cannot the taunt of "high and low chemists" be done away with, or properly met? Mr. Tatlock, in a letter to me, puts the reason of these discrepancies so well that I quote his words:—"They arise from the adoption of so many different processes, and from want of attention to the reliable work that has been done in investigating the methods; the general tendency among chemists being to read papers written by investigators, pass a verdict upon them, and proceed in their usual way, taking no pains to test the improved methods for themselves, much less to adopt them." In fact, it is nobody's business, but yet it is a crying evil and a disgrace. I do not expect to put a stop to occasional variations, but I want the processes and statements standardised by competent authority. On the Continent, one of the scientific societies would appoint a committee to inquire into these processes, and decide and report on the best. Our Chemical Society would probably not hear of this, but I see no reason why the Chemical Section of the British Association should not take it up. They have already appointed a Committee to inquire into the discrepancies amongst gold assayers, differences which are infinitesimal compared to those we complain of; and that committee has already done very good work and added much to our knowledge. I could adduce a number of other commercial analyses the methods of which require looking into, but I propose, in the first instance, to ask them to appoint a committee provided with a suitable grant of money to undertake the investigation of the processes employed in the commercial analysis of superphosphates and salts of potash, and the statement of results.

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* Henderson, "On the Decomposition of Sulphate of Potash by Nitrate of Soda."—*Proc. Phil. Soc. of Glasgow*, vol. viii., p. 457.

ON THE

ANALYSIS OF NICKEL AND COBALT ORES AND FURNACE-PRODUCTS,

AND ON A

CONVENIENT AND ACCURATE METHOD OF SEPARATING ZINC FROM NICKEL AND COBALT.*

By R. FRESENIUS.

The ore or furnace-product in fine powder is treated with hydrochloric acid, with the addition of nitric acid, until everything soluble has been dissolved. It is then repeatedly evaporated with hydrochloric acid almost to dryness, in order to expel the rest of the nitric acid. The residue is taken up with hydrochloric acid and water, and filtered. If a residue is left not perfectly white, it is fused with bisulphate of potash, the melted mass treated with hydrochloric acid and water, and the solution filtered, and added to the former. A current of sulphuretted hydrogen is passed through the liquid, which contains a sufficiency of hydrochloric acid, so as to throw down all precipitable metals, the gas being passed in first at the temperature of 70° C., and afterwards in the cold. The filtrate is heated first alone, and then with the gradual addition of nitric acid, to convert the protoxide of iron completely into peroxide. Ammonia is now added in excess; the impure hydrated oxide of iron filtered off, washed a little, dissolved in hydrochloric acid; the solution considerably diluted, mixed with sal-ammoniac, and then, in the cold, with a dilute solution of carbonate of ammonia until the liquid takes a somewhat turbid appearance, without, however, the formation of a precipitate. On standing, it should not become bright, but, of the two, rather more turbid. The reaction of the liquid is still decidedly acid. It is heated now to a boil, the precipitate of basic per-salt of iron is washed with boiling water, first by decantation, and then upon the filter, and a portion of the basic salt is then tested by dissolving in hydrochloric acid, repeating the basic precipitation, and testing the filtrate with sulphide of ammonium for traces of nickel. If, in this operation, nickel is found, the entire precipitate is dissolved in hydrochloric acid, and the oxide of iron once more separated out as a basic salt in the same manner. The two or three filtrates, as the case may be, containing the nickel and cobalt are now mixed together, acidulated with acetic acid, and concentrated by evaporation. If a slight precipitate is separated (oxide of iron or alumina), it is filtered off, re-dissolved in hydrochloric acid, the solution precipitated with ammonia in excess, and the operation again repeated. The filtered and sufficiently-concentrated solution, containing all the nickel and cobalt, is now mixed with carbonate of soda till the reaction becomes distinctly alkaline; acetic acid is added till it predominates. To the clear liquid, 30 to 50 c.c. of a solution of acetate of soda, containing one-tenth its weight of the dry salt, and sulphuretted hydrogen, is conducted into the liquid at a temperature of 70° C. When the precipitation is complete, the sediment of the sulphides of nickel and cobalt is filtered off, washed, and dried. The filtrate is concentrated, sulphide of ammonium, containing an excess of sulphuretted hydrogen, is added, and afterwards acetic acid, and thus a second precipitation of sulphides of nickel and cobalt is often obtained. For safety's sake, the filtrate is tested once more, to be quite certain that all nickel and cobalt has been precipitated in the state of sulphide. The dried sulphides of nickel and cobalt, together with the ash of the filter, is now treated with hydrochloric acid, with the addition of nitric acid, until completely decomposed and dissolved. The solution is evaporated with hydrochloric acid, in order to expel the nitric acid, diluted with water, filtered, and the solution precipitated with pure potassa-lye, preferably in a large platinum capsule. The precipitate obtained is thoroughly washed with boiling water, first by decantation, and then on the filter. It is then heated in the air till the filter is completely incinerated, and ignited in a Rose's crucible in a stream of pure hydrogen till the weight is constant. The metallic cobalt and nickel are treated in the crucible with boiling water. If the liquid shows an alkaline reaction, or the presence of chlorine or sulphuric acid, or leaves a residue when evaporated on platinum-foil, the metals are exhausted with boiling water, again ignited in a stream of hydrogen, and weighed again. The metals are now dissolved in nitric acid, whereby generally a small quantity of silicic acid remains undissolved. It is collected upon a small filter, and its weight determined. The nitric acid solution is almost neutralised with ammonia, carbonate of ammonia is then added in excess, and the whole gently heated for some time. The slight precipitate of hydrated oxide of iron and alumina which is usually formed is filtered off, dissolved in hydrochloric acid, and re-precipitated with carbonate of ammonia. The small precipitate is ignited, first in the air, and then in a stream of hydrogen, and its weight, together with that of the silicic acid, is deducted from the gross weight of the metals.

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* *Zeitschrift für Analytische Chemie.*

If the ores or furnace-products contain zinc, the mixture of nickel and cobalt obtained as above contains zinc. In this case, the hydrochloric solution, obtained by dissolving the sulphides of nickel and cobalt, after it has been reduced to a small volume, is mixed with pure chloride of ammonium in small crystals, to such an extent that 5 parts of chloride of ammonium are allotted to 0·2 of oxide of zinc. The moist saline mass is evaporated to dryness on the water-bath, and carefully heated till all the sal-ammoniac, and with it all the zinc, has been volatilised. The residue of metallic nickel and cobalt is dissolved in hydrochloric acid, with the addition of nitric acid; the greater part of the free excessive acid is driven off, the residue precipitated with potassa, and treated further as above.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

A MEETING was held in the Physical Laboratory, South Kensington Museum, on Saturday, April 18, Dr. Gladstone, F.R.S., the President, in the Chair.

Dr. W. H. STONE read a paper "*On Wind-Pressures in the Human Chest during Performance on Wind-Instruments.*"

Mr. A. TRIBE showed experiments illustrating the action of hydrogen upon finely-divided metals, such as are produced by precipitation.

At the next meeting, to be held at 3 p.m. on Saturday, May 9, the following papers will be read:—Dr. Rae, "On certain Physical Properties of Ice." Dr. Guthrie, "On an Absolute Galvanometer." Dr. Stone, "On the Fall in Pitch Occurring in Strained Wires through which a Galvanic Current is Passing."

NOTICES OF BOOKS.

The Birth of Chemistry. (Nature Series.) By G. F. RODWELL, F.R.A.S., F.C.S., Science Master in Marlborough College, London. Macmillan and Co.

THE history of chemistry, or, indeed, of any branch of science, is not a favourite subject in England even with the initiated, not to speak of the half-educated "intelligent and respectable." With the exception of Dr. Thompson's work, now somewhat out of date, and of the very meagre account of the rise and progress of chemistry in Whewell's "History of the Inductive Sciences," our literature in this department is almost a blank. Mr. Rodwell has, therefore, selected no hackneyed subject. His object, as stated in the preface, is "mainly that we may mark the attitude of thought which actuated the scientific mind in bygone times, and may thus be led to compare the ancient with the modern method of evolving ideas, and building them up into a connected whole."

The author successively passes in review the primitive theories affecting the history of matter, the metallurgy of the ancients, alchemy, early ideas respecting the nature of combustion and the rise of pneumatic chemistry. As regards the antiquity of the science, he takes a medium view, neither seeking its origin as far back as the days of Moses, nor, with certain French authorities, pronouncing it to have arisen suddenly in France in the eighteenth century. The work bears the impress of careful and critical study, and of decided originality of view.

A variety of illustrations, representing ancient and mediæval apparatus, symbols—complex enough to find favour in the present day—and allegorical representations of reactions and processes, with facsimiles of portions of alchemical manuscripts, enhance the interest of these pages. We can cordially recommend Mr. Rodwell's little work to all students of chemistry, and we hope that he may on some future occasion return to the subject and continue his history down to the present day.

Report on Public Health. By C. A. CAMERON, Ph.D., M.D., &c. London: Falconer.

A SERIES of essays having no other connection than their common bearing upon public health. The author treats first on "Nitrogen Compounds in relation to Water Contamination." He thinks it necessary to determine, in addition to the ammoniacal salts and albumenoid ammonia in waters, the gypsum and the chlorine. He considers that in "limestone districts water which had never been contaminated with sewage often contains very large amounts of nitric acid." This circumstance, to which Dr. Cameron calls the especial attention of sanitary chemists, makes strange havoc of the doctrine of "previous sewage contamination."

Next follows a paper on the "Mortality of Flax-Mill and Factory Workers," with reference to the effects of dust on the respiratory organs. In the next essay Dr. Cameron takes up the vexed question of "Typhoid Spread of Milk." We have already expressed the opinion that zymotic disease may be thus propagated; at the same time, we cannot help pointing out that the number of cases of enteric fever in the western districts of London has been this year below the average. The paper on the "Management of Children" has no direct chemical interest. More important are the remarks on the "Hygeine of Dwellings," couched in the form of a critique on Pettenkofer's work on "The Relations of the Air to the House We Live In and the Clothes We Wear." The significant fact is pointed out that in loose soils especially there is a large amount of air richer in impurities than in the air above ground. This underground air may be drawn into the interior of houses, owing to the temperature within being higher than that without, and producing an ascending current like that in a chimney. Our houses ventilate themselves, not only through the walls, but also through the ground on which they stand. Says Pettenkofer: "We took rather a short-sighted view all the while when we believed that the nuisances of our neighbours could only poison the water in our pumps: they can also poison the ground—air for us—and I see more danger in this, as air is more universally present and more mobile than water."

We must here call attention to a novel danger. If the surface of the ground in the streets is rendered practically air-tight by a layer of asphalte, all subterranean gases and vapours will find vent in our houses, where no such resistance is encountered, and which must serve as up-cast shafts for the whole district. It would, therefore, be a wise precaution to underlay every house with a layer of asphalte thicker than that in the streets, so that the resistance indoors may be greater than that without. We are glad that Dr. Cameron has officially called public attention to the contamination of the air from below.

Spectrum Analysis as Applied to Microscopic Observation. By W. T. Suffolk, F.R.M.S. London: J. Browning.

The use of the spectroscope as an auxiliary in microscopic research is, as yet, in its infancy. The published matter relating to the micro-spectroscope is, as the author states in his preface, scattered through the pages of various scientific periodicals. A book like the present is therefore needed for the guidance of beginners. The main portion of the work is the substance of a lecture delivered before the South London Microscopical Club. To this has been added an appendix on the structure and use of the micro-spectroscope, a list of papers in various scientific journals on absorption-spectra and the micro-spectroscope, and a number of plates with explanations.

We hope that this little work may prove the means of inducing an increased number of observers to turn their attention to a subject as yet all but unexplored.

Second Annual Report of the Imperial Mint, Osaka, Japan. For the year ending July 31st, 1873. Printed by order of the Council of State. Hiogo: "Hiogo News" Office. 1873.

This pamphlet gives an interesting proof of the progress of physical science in Japan. That there is in that far distant realm a Mint, fitted up with all the chemical and mechanical appliances known in Exrope, will possibly be news to some of our readers. We find that sulphuric and nitric acids of good quality are now manufactured in Japan, and that the refinery is "capable of undertaking for the public the parting of gold and silver, and also the purification of these metals, at very moderate charges." Mr. Miller's apparatus for treating "brittle" gold with chlorine has been erected, but the quality of the bullion sent in has been such as not to require its use.

A memorandum of Mr. Gowland, chemist and metallurgist to the Mint, contains some interesting particulars on refractory clays, and on Japanese coal and copper. Some of the kaolins compare favourably with the best Stourbridge fire-clay; others are fusible from the presence of iron or of alkalies. The ash in five samples of coal previously dried at 100° C. was high, ranging from 6·487 to 12·760; the percentage of sulphur varied from 0·383 to 0·654 per cent, which, as Mr. Gowland remarks, is less than that present in average British coals. The samples of Japanese copper examined were remarkably free from antimony, and generally from arsenic. One sample, however, contained 0·159 per cent of arsenic, and another 1·384 of lead. Certain crude Japanese coppers contain so much iron that a modification of the ordinary mode of refining should be adopted.

It is satisfactory to learn that all the chemical posts in connection with the Imperial Japanese Mint are filled by Englishmen.

Instructions in Photography. By Captain Abney, R.E., F.C.S., F.R.A.S. London: Piper and Carter.

The elementary literature of photography has been tolerably copious in this country. There has been no lack of instruction books; but they have been, for the most part, characterised by two faults—they have been empirical and shoppy. Some of them have contained intelligent instructions for practice, but have been silent or erroneous as to the scientific bases of the art; whilst others have been manifestly prepared to aid the business purposes of the dealer in photographic material. The manual before us is free from both the drawbacks we have indicated. Captain Abney's instructions were, we understand, originally prepared to aid the studies of the Engineers at Chatham, where the photographic tuition is under his charge. Besides being simple and lucid in style, and comprehensive in its range, the work possesses two good qualities, which are worthy of note. In the first place, all the instructions possess the manifest authority which familiar practical knowledge gives to a writer; and, in the next place, an attempt is made throughout to explain the *rationale* of the various reactions resulting from the operations under hand. To avoid embarrassing the beginner with explanations, which he could scarcely understand until he was familiar with the operations to which they refer, these explanations are given as notes accompanying the text, which may, however, be read without the notes or with, as the proficiency of the student may dictate. All the usual branches of photography are exhaustively treated, and especially full information is given on the subject of photo-mechanical printing, in which Captain Abney is an expert. Altogether, the manual is one we can commend to all interested in the study of photography.

CORRESPONDENCE.

ANTHRACEN.

To the Editor of the Chemical News.

Sir,—In answer to Mr. T. H. Davis's article on anthracen in Chemical News, vol. xxix., p. 169, I beg to draw his attention to my lecture on anthracen and alizarin, delivered at the Society of Arts on March 20. I think Mr. Davis will find that in my paper, and in the subsequent discussion, all the points were thoroughly ventilated to which he draws attention.—I am, &c.,

Fred. Versmann.

18, Billiter Street, London,
April 23, 1874.

ADULTERATION OF FOOD.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxix., p. 162, you honoured me with a critique of my little book on "Adulterations of Food," and in the course of your remarks stated that you regret I still attach a certain value to the indications of the lactometer. From the sentence immediately following, I gather that in your opinion a lactometer is an instrument constructed on the principle of the hydrometer, and you give an excellent reason why the indications of such an instrument are likely to be fallacious. I beg, however, to inform you that the instrument I speak of and describe in "Adulterations of Food" is not at all adapted for the purpose of taking the specific gravity of milk, but is simply to be used in the measurement by volume of the proportion of cream present in that fluid.

With regard to the statement made by Dr. Muter in the *Food Journal* (vol. ii., No. 13), respecting the adulteration of wine with elderberries, I opine that the terms "jerupigia" and "elderberry brandy" are synonymous.

I am grieved that Mr. Estcourt fails to see a resemblance between my drawings and his tea-leaves; the former were nevertheless copied from Nature.—I am, &c.,

Rowland J. Atcherley.

London, April 27, 1874.

INDIRECT ESTIMATION OF POTASH AND SODA

To the Editor of the Chemical News.

Sir,—The publication by Mr. F. Maxwell Lyte of a note on this subject brought to my recollection some calculations I made more than twenty years ago in the same direction. On turning up a note-book of the period, I find the following:—"To calculate the respective quantities of sulphate of potash and sulphate of soda in a mixture of those salts, multiply SO_3 by 9·65156, and subtract result from weight of mixed sulphates × 5·4375; the result is sulphate of potash, and the remainder of the mixture sulphate of soda." I also find the following:—"To calculate the respective quantities of KCl and NaCl in a mixture, salts × 4·6564 − Cl 7·673 = KCl." I distinctly remember applying the latter formula to the analysis of commercial potash salts (such as "muriate of potash") in this way—The SO_3 was calculated to K_2SO_4, and this, with the H_2O, insoluble, and Na_2CO_3, deducted from 100; the remainder was KCl and NaCl, from which the respective salts were calculated by the above method. I have applied the same system to the estimation of Fe_2O_3 and FeO in a mixture, and, in fact, the principle is applicable to all cases where these elements are present, one of which can be estimated with accuracy.

As regards the estimation of potash, I would not like to hazard my reputation as an analyst upon results obtained by the indirect method. The platinum process, as improved by Mr. Tatlock, gives results of such accuracy as to satisfy all the requirements, not only of trade, but of scientific investigation.—I am, &c.,

William Wallace.

42, Bath Street, Glasgow,
April 22, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 9, 1874.

Note on the Theory of Swell.—M. Resal.—This theory, as lately propounded, is only applicable, the author thinks, to comparatively small sheets of water, as lakes, and the rotation of the earth is neglected, which in certain oscillations plays an important part.

Note on a New Spiral Regulator for Chronometers and Watches.—M. Phillips.—The author sought to make the flat spirals more conformable to theory, by furnishing besides the exterior theoretical terminal curve a second and interior one, corresponding to the other end of the spiral. The chronometers thus fitted are shown to have been greatly improved as regards isochronism.

Researches on Crystalline Dissociation (continued); Estimation and Distribution of Work in Saline Solutions.—MM. Favre and Valson.—The authors here give results of comparison, as regards volume change, between normal saline liquors of acids, and the bases giving rise to them.

Particular Arrangement of Micrometer with Movable Wires, Proposed for Telescopes to be used in Observing the Transit of Venus.—M. Hatt.—One important point in the transit observations is to measure the distance of the planet from the sun's border. The micrometer suitable for this is less so for another important measurement, that of the common chord between the two stars during entrance or exit; appreciation of the instant when this chord attains a determinate size. M. Hatt's arrangement is meant to meet this want.

Additional Note on Waves of Variable Height and Velocity.—M. Bertin.

Dispersion of Gases.—M. Mascart.—The author shows how his method for measuring refraction of gases may here be applied. This method was, briefly, as follows:—The apparatus consisted of a spectroscope, in which the collimator was considerably apart from the refringent prisms. The parallel rays from the collimator were, by one of M. Fizeau's biplates, cut into two parallel bundles separate by several millimetres. These bundles traversed two tubes of gas, closed with glass plates, were then brought together again by means of a biplate having a direction opposite to that of the former, and were largely refracted by the prisms. The two bundles being caused, by difference of pressure in the tubes, to progress differently, the order of the fringe F observed at a point of the spectrum with wave-length λ is connected with the difference of progression, Δ, by the equation $\Delta = F\lambda$. Then, on gradually altering the pressure in one of the tubes, the fringes are seen to move towards the red or towards the violet, according as the difference of pressure increases or diminishes. For measuring dispersion the author illuminates the collimator with a Drummond light, and also makes some induction sparks pass before the slit. The spectrum is illuminated throughout, and one can observe the bright lines of metallic vapours and Talbot's bands. One of the two gas tubes being at pressure H, the observer counts the number of fringes between the different bright lines. The pressure is then changed to H_2, and the fringes between the same lines are counted anew. M. Mascart gives the numerical results in the case of several gases. It appears that the dispersion is not in direct relation with either the refraction or the density of the gas. Certain gases, as protoxide of nitrogen and cyanogen, have a dispersion superior to that of water.

Wave-Lengths and Characters of Violet and Ultra-Violet Solar Rays, obtained Photographically by means of a Grating.—Prof. Draper.—This paper has already appeared in English form.

Probable Character of the First Fortnight of March.—M. De Tastes.

On Hydrogenised Palladium.—MM. L. Troost and P. Hautefeuille.—The authors find that the "occlusion" of hydrogen in palladium is a phenomenon more complex than was previously supposed. They examine the two questions,—Does hydrogen combine with palladium, or is it simply dissolved in that metal? If there is combination what is the formula of the compound produced? Their experiments show that palladium forms with hydrogen a definite compound, Pd_2H. This compound, when once formed, can dissolve hydrogen in amounts varying with its physical condition. This property of the compound, Pd_2H, explains the difference of the results obtained by Graham, according as he used palladium in the state of wire or of sponge.

Apparatus for the Determination of the Tannin Contained in the Astringent Matters used in Tanning.—M. A. Terreil.—We notice this paper elsewhere.

Use of the Sulphate of Copper for Preserving Wood as Compared with the Tannate of Iron.—M. A. Hatzfeld.—This paper is also noticed elsewhere.

Reply to the "Reclamation" of M. Béchamp on the Beer-Yeast Question.—M. P. Schützenberger.—The writer admits the priority of M. Béchamp as regards the discovery of the gummy matter and of tyrosin, but claims for himself the discovery, in yeast, of carnin, xanthin, guanin, and sarcin.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, February 23, 1874.

Constitution of Phenyl-Bromethyl and its Derivative Hydrocarbons.—Br. Radziszewski.—This paper is not adapted for abstraction.

Action of Sulphur upon the Benzoate of Baryta.—Br. Radziszewski and A. Sokolowski.—The results of the reaction are very complicated, but neither tolan nor sulphate of baryta is formed. Among the products obtained are benzol, benzoic acid, diphenyl, benzophenon, a mercaptan compound boiling at a high temperature, a residue of carbon and sulphide of barium, and a gaseous mixture containing sulphuretted hydrogen and carbonic acid.

Presence of Leucin and Asparagin in the Recent Juice of Vetch-Sprouts.—The author found these substances in the sprouts of vetches that had germinated in darkness.

Constitution of Dinitro-Benzol.—C. Wurster.—A lengthy hypothetical paper, not adapted for abstraction.

Crystallographic and Chemical Relations of the Natural Sulphides, Arsenides, and Sulpharsenides.—C. Rammelsberg.—The author, after referring to the well-known heteromorphism of the metallic sulphides, especially the bisulphide of iron, shows that the two forms of the latter recur in certain metallic sulpharsenides, and in such a manner that we are perfectly justified in regarding this resemblance as isomorphism. FeS_2 is isomorphous with FeAsS, CoAsS, and NiAsS. But it does not follow that arsenic and nickel are isomorphous. The isomorphism of compounds does not prove the isomorphism of their respective constituents. The second form of FeS_2, cock's-comb pyrites, is repeated in arsenical pyrites. There are, in fine, two heteromorphous series of metallic compounds whose members consist either entirely of RS_2, or of R_mAs_n, or of a mixture of both. They may be named the pyritic and markasitic series. Those arsenical compounds in which R is exclusively iron, rarely iron and cobalt or nickel, are known only in the markasitic series and comprise the bodies known as arsenical iron and arsenical pyrites. The very numerous mixtures in which R stands cobalt, nickel, and iron are found in both series.

The Fermentation Question.—J. Moritz.—The author contests the view of Brefeld that the vital, but not growing, yeast cell, in the absence of free oxygen, excites alcoholic fermentation in solutions of sugar, from which it would follow that in the fermentation of wine air should be excluded instead of admitted as practice indicates. He deduces from his experiments that the growth of yeast is directly proportional to fermentation.

Certain Compounds of Aldehyd.—M. Nencki.—An examination of ethyliden-benzamid, ethyliden-urethan, and diethyliden-sulphurea.

On Substituted Phenol-Sulphacids.—Jul. Post and Fr. Brackebusch.—Not adapted for abstraction.

On Bromo- and Iodo-Nitro-Sulpho-Phenol Obtained from Ortho-Nitro-Phenol—Jul. Post and Fr. Brackebusch.—The authors have prepared iodo-nitro-sulpho-phenol and bromo-nitro-sulpho-phenol, and have examined certain of their salts.

A Lecture Experiment with Potassium.—H. Kæmmerer.—The author shows the green vapour of potassium by evaporating the metal in a current of hydrogen gas in a wide horizontal tube.

On Derivatives of Diphenyl.—A. Osten.—The compounds examined and described are—Mono-nitro-diphenyl; monamido-diphenyl; hydrochlorate of monamido-diphenyl; sulphate, oxalate, and nitrate of the same base; hydrochlorate of monamido-diphenyl-platin chloride; mono-hydroxyl-diphenyl; and acetamido-diphenyl.

Explanation of the Difference in the Boiling-Points or Metameric Bodies.—Alex. Naumann.—A hypothetical paper, not suitable for abstraction.

On Cresol-Colouring Matters.—H. Wichelhaus.—The salt of binitro-cresol which gives occasion for this notice was obtained from the Vienna Exhibition last year, where the artificial yellow colouring matters shown were picric acid, chrysanilin, and binitro-naphthol. Dusart exhibited mono-nitro-naphthol, which is no commercial product, but a laboratory preparation. In the Belgian Section was seen a "gold-yellow," which at first sight resembled the salt of mono-nitro-naphthol, but showed a decided difference upon closer examination; it consisted of brown granular masses, which deflagrate briskly when heated, and dissolve in water with an intense yellow colour. It is the potash salt of binitro-cresol—

$$C_6H_2(NO_2)_2CH_2HO.$$

Third Nitro-Phenol Corresponding to Dinitro-Benzol.—R. Fittig.—Not adapted for abstraction.

Molecular Compound of Acetic Acid with Bromine and Hydrobromic Acid.—A. Steiner.—This compound consists of—

Bromine	44·3
Hydrobromic acid..	22·5
Acetic acid	33·2
	100·0

New Synthesis of Succinic Acid.—A. Steiner.—Succinic acid was obtained by heating together equal equivalents of chloro-carbonic ether, bromacetic acid, and powdered silver, at 130° in a sealed tube.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 3, March, 1874.

Report on Constantin's Procedure for Glazing Cheap Earthenware.—M. Salvetat.—The author calls attention to the imperfections and dangers of the common lead-glazes, and proposes the following mixture:—

Silicate of soda at 50°	100 parts
Red-lead..	25 "
Finely-ground flints	10 "

The glaze thus produced is not attacked by vinegar or by fatty matters.

Assimilation of Nitrogen by Plants.—In a notice of Deherain's work on agricultural chemistry, recently published, the important question is raised—In what form is nitrogen assimilated by plants. Kuhlmann maintains that nitrates are not taken up until reduction has taken place, and their nitrogen has entered into an ammoniacal combination. On the other hand, Cloëz holds that ammoniacal salts are inactive till their nitrogen has passed into a nitro-compound. Neither of these views has as yet been demonstrated. M. Deherain combats the view of M. Ville that plants can assimilate directly the free nitrogen of the atmosphere, but he holds that in soils containing decomposing organic matter the nitrogen of the air forms ammonia in the absence of oxygen. Carbonic acid is formed, and the nascent hydrogen unites with the atmospheric nitrogen to form ammonia.

Nitrification of Vegetable Soil.—M. Boussingault.—The author has formerly attempted to point out the analogy between a nitre-bed and a manured arable soil. He has now undertaken a series of experiments to determine what share the nitrogen of the atmosphere has in the process of nitrification. The result was that in the nitrification of a vegetable mould, accomplished in a confined and unrenewed portion of stagnant air, the nitrogen of the atmosphere takes no part. The nitrification in such cases takes place at the expense of nitrogenous organic matter.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 8, February 19, 1874.

This number contains no chemical matter.

No. 9, February 26, 1874.

Use of Glycerin to Prevent the Formation of Incrustations in Steam-Boilers.—M. Asselin, of Paris.—Glycerin, added in the proportion of 1 kilo. for every 5000 to 8000 kilos. of fuel consumed, is recommended on account of its power of increasing the solubility of sulphate of lime, and causing the undissolved portion to be precipitated in a granular form, so as not to adhere to the metal.

Action of Sulphuric Acid upon Decidene (Essence of Turpentine).—E. J. Maumené.—The author, in opposition to Deville and Ribau, maintains that the sole product of the reaction is decifene (cymene).

No. 10, March 5, 1873.

This number contains no original chemical matter.

No. 11, March 12, 1874.

The Absorption-Spectra of Blood.—M. Fumouze.—This is a notice of a work on the above subject, too lengthy to be transferred to our pages.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, November and December, 1873, January and February, 1874.

These numbers contain no chemical matter, except a paper on the manufacture of white-lead, which has already appeared in the Chemical News.

MISCELLANEOUS.

Adulteration of Food.—During the year 1873 Dr. Cameron made 386 analyses of food and drink, of which 108 were adulterated, 16 pure but of bad quality, and 262 pure. Of the adulterated specimens, the milk was adulterated with from 12 to 120 per cent of water, but with no other adulterant. The bread was adulterated with alum, and in some instances it contained a large quantity of sandy matter. The flour was adulterated with alum, and six of the samples contained grit or sandy matter. The tea was composed of exhausted and decayed leaves, strengthened by the addition of some stringent gums. The coffee was adulterated with chicory and burnt sugar. The rum was wholly spurious, being new whiskey sweetened with treacle, and being 25 per cent under proof. The butter examined contained no foreign matter, but four samples were rancid and unfit for use. The oatmeal was very mouldy, full of fungoid growths, and unfit for use. Twenty-three well waters used in Dublin were examined, and of these 16 proved to be loaded with dangerous organic impurities, and were utterly unfit for use. Fourteen specimens of green wall paper on sale in the city were examined, and fourteen of them found to be coloured with arsenical green. The following quantities of food were condemned as being unsound:—

Beef	147,815 lbs.
Veal	2,100
Mutton	6,640
Pork	19,356
Bacon	7,139
Fish	34,220
Butter	72
Fruit and vegetables	450
Bread	6,000
Flour	560
Tea	200
Total	224,552

The fines and costs imposed on 43 persons convicted for selling adulterated food amounted to £252 11s. Of the 21 persons convicted for selling or being possessed of diseased or unsound meat, 11 were fined £49 17s. The others, 10, were imprisoned—3 for 3 months each, 3 for 2 months each, 2 for 6 weeks, and 2 for 14 days each. Total convictions, 64. During the last four years 1438 sanitary analyses have been performed, 1,432,521 lbs. of unsound food condemned, 139 persons fined for selling adulterated food, 72 persons fined for selling or having in their possession diseased meat, and for the latter offence 21 persons were imprisoned for periods varying from 14 days to 3 months. The fines imposed amount to nearly £1,000. The names, offences, &c., of several adulterators were advertised at their own expense.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of metallic alloys, and in apparatus to be used for this purpose. Alexander Parkes, Gravelly Hill, near Birmingham. June 19, 1873.—No. 2151. This Provisional Specification describes an apparatus and process for making principally alloys of copper and manganese.

An improved process for preserving wood. Charles Brown, M.D., 8, Southampton Buildings, London. June 20, 1873.—No. 2156. The nature of my invention consists in filling the pores of the wood with lime, or a mixture of lime and sand.

Improvements in the manufacture of soda and chlorine. Alexander Robertson Arrott, chemist, Saint Helen's, Lancester. June 27, 1873.—No. 2236. This Provisional Specification describes the manufacture of soda and chlorine from common salt. For this purpose, phosphate of peroxide of iron and common salt are exposed at a red heat in a suitable furnace to the action of air or steam, or both, by which means the common salt is decomposed.

An improved liquid for destroying vegetable life and checking its development. Spencer Dunn, manufacturing chemist, Princes Square, Finsbury, Middlesex. July 1, 1873.—No. 2278. The liquid contains arsenic in sufficient quantity to kill weeds or destroy vegetable life and check its development.

Improvements in the treatment of finely-divided iron ores, iron-sands, or mine-dust, with a view to smelting the same in blast-furnaces. Martin Rae, Uphall, Linlithgow, N.B. July 2, 1873.—No. 2297. The difficulty hitherto preventing the smelting of finely-divided iron ores, iron-sands, and mine-dust, are as follows:—If these ores are used alone, they stop up the draught of the furnaces altogether, or are blown out at the throat if the blast is increased to overcome the obstruction. To obviate this difficulty, various plans have been tried, by mixing the ores with clay, mud, and other plastic materials, but hitherto without success, on account of the agents employed being of a non-combustible character, the furnaces requiring a larger percentage of fuel, and producing a greater amount of slag than usual. Now, my invention consists in the preparation of a mastic from the residues of the distillation of mineral oils, as is well understood, which mastic I use as a cement for binding the iron ore or mine-dust together, and by pressure I convert the same into solid blocks, which blocks can then be smelted in a blast-furnace. In districts where the aforesaid ores are located near to blast-furnaces, it may be found economical to mix the ore or mine-dust with a due proportion of coal-dust, coke-breese, or powdered charcoal, to act as fuel; also a due percentage of powdered lime, to act as a flux; this composition to be mixed with the aforesaid mastic, and pressed into blocks as above set forth.

Improved processes for plating iron, steel, and other metals with nickel. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Henry Tudor Brownell, Hartford, Connecticut, U.S.A.). July 2, 1873.—No. 2302. I apply nickel to the iron, steel, copper, brass, or other metal, either by electro-plating or any other of the ordinary methods of covering metals with a thin film of nickel, and then subject the metal so plated to a temperature of from 480° to 700° F., or the metal is first heated in water at or near the boiling-point, and is then immersed in the plating-fluid heated to the same temperature.

Improvements in the treatment of sewage-water, and in the manufacture of manure. Jeremiah Marsden, iron founder, and John Collins, analytical chemist, Bolton. July 4, 1873.—No. 2317. Our invention consists in subjecting sewage-water to the action of certain agents, by which the solid and fertilising portion is precipitated to be converted into manure, and the water is cleared and allowed to run off. The agents we employ are lime, coal ashes, or other refuse of coal, and charcoal or carbon, combined with a salt of soda, potash, iron, manganese, or the like.

NOTES AND QUERIES.

Determination of Anthracen.—(Reply to "Student.")—Consult the Chemical News of April 17, and some of the older numbers. The following works also give a quantity of valuable information on this subject:—"Traité des Dérivés de la Houille," and "Das Anthracen und sein Derivative."—T. H. Davis.

MEETINGS FOR THE WEEK.

Monday, 4.—Medical, 8.
— Society of Arts, 8. Cantor Lectures.
— London Institution, 4.
Tuesday, 5.—Civil Engineers, 8.
— Anthropological, 8.
— Zoological, 8.30.
Wednesday, 6.—Society of Arts, 8. P. E. Thicke, "On Timber Houses."
— Microscopical, 8.
Thursday, 7.—Royal, 8.30.
— Royal Society Club, 6.
— Chemical, 8. Dr. Tommasi, "On the Constitution of Urea." Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; Part VII., On the Chlorides of Ethylene and Ethylidene." Mr. A. Liversidge, "On a Mineral from New Caledonia."
Friday, 8.—Society of Arts, 8. Dr. Griffin, "On Sugar Refining."
— Quekett Microscopical Club, 8.

THE CHEMICAL NEWS.

Vol. XXIX. No. 754.

ON THE INDIRECT DETERMINATION OF ALUMINIUM OXIDE IN THE PRESENCE OF FERRIC OXIDE.

By R. W. EMERSON MACIVOR.

The aluminium and ferric hydrates are thrown down from solution in the ordinary manner, by the addition of ammonium hydrate, and the precipitate is collected on a filter, dried, ignited, and weighed. The ignited precipitate is then rubbed to a fine powder in an agate mortar, and carefully washed into a long necked flask. Metallic zinc (quite free from iron) is next added to the contents of the flask, and finally some sulphuric acid. The whole is then heated over an argand burner until the oxides have dissolved. The quantity of iron in the fluid is then estimated volumetrically by the potassium permanganate process. From the iron found, the quantity of ferric oxide contained in the precipitate is calculated, and this amount subtracted from the total weight of the mixed oxides gives, of course, the quantity of aluminium oxide contained in the mixture.

This process is rapid of execution, and gives good results.

67, Park Road, Glasgow,
May 2, 1874.

ANALYSIS OF ASHANTEE GOLD.

By Prof. A. H. CHURCH.

As a special interest is attached to the subject of the native gold of Ashantee just at present, I have submitted to analysis a fair sample of the metal, cutting off portions of several small nuggets for that purpose. The colour of the nuggets is very uniform and rich, and would indicate, perhaps, the presence of a smaller quantity of alloy than that which actually occurs in them. The surface-colour of this native gold is further deepened by the red hæmatitic earth which adheres to it. Now and then, however, a nugget of paler tint may be observed, but the difference of tint is not due in the cases I have examined to the presence of more alloy, but rather to the less compact character of these specimens, and to the fact that they contain, in lieu of a red ferruginous mineral, traces of a dark siliceous earth.

A most careful analysis of an average sample of Ashantee native gold gave me the following numbers:—

	In 100 parts.
Gold	90·055
Silver	9·940
Copper	very minute trace
Iron	trace

Specific gravity at 16° = 17·55.

ANALYSIS OF ANIMAL CHARCOAL (BONE-BLACK).

By G. COMBE STEWART, F.C.S., Greenock.

The importance of the study of chemistry is now generally acknowledged; besides the various observations in Nature which excite curiosity the experimental method furnishes one of the most salutary exercises for the mind, constituting in this respect a fitting supplement to the study of the mathematical sciences.

The method of deduction in these, while eminently adapted to form the habit of strict reasoning, scarcely affords any exercise for the critical faculty, which plays so important a part in chemical science.

In the many branches in which chemistry is applied to this art that section which treats of the analysis and manipulation of animal charcoal is the most important. The chemical analysis of animal charcoal forms the foundation plate of success in working it in that great laboratory, the sugar refinery. In it all the work done should be conducted on chemical principle, and no sugar-refiner who works contrary should expect too much from any sample of charcoal, because there is no substance in which he is more apt to be deceived than the treatment of this material on any other principle than that of modern scientific basis.

Charcoal to the eye may exhibit satisfactory properties and yet be totally useless for sugar refining; yet, notwithstanding this fact, some merchants expect the same work from it as from a genuine sample. If the charcoal does not possess chemical properties, which are characteristic of the finest bone-black, how can a sugar-refiner hope to take it out of it in the face of chemical facts? No; facts are facts—natural philosophy follows.

Knowing, then, that the proximate analysis of animal charcoal is of the highest importance, the following general process and remarks will be found very suitable in effecting such.

In determining the moisture, carbon, and total organic matter, a weighed portion of the charcoal may either be submitted to direct combustion in a suitable furnace, collecting the products in the usual manner, or the moisture may be determined by drying a weighed quantity in the hot-air chamber at a temperature of 160° to 180° C. for six hours. The loss in weight is moisture, and on ignition of the residue it will supply the sum of the carbon and organic matter. In careful hands both processes are excellent, and should correspond with each other, remembering the fact that charcoal when ignited the loss in weight is equal to the sum of the moisture + carbon, + total organic matter.

Should it be desired to determine the carbon by the *solution* method, viz., treatment with hydric chloride, the carbon is obtained insoluble, mixed up with the siliceous matter, which can be separated by direct ignition. Particular attention must, however, be bestowed to this carbonaceous residue in determining the carbon by this method. I have found considerable difficulty in washing it free from hydric chloride, and in drying it so as to obtain the siliceous matter with accuracy on ignition.

By attaching to the filtering apparatus a suction-pump (such as is described on page 61 of Dr. Thorpe's "Quantitative Chemical Analysis") the residue may be obtained in a very superior manner and leaves nothing to be desired. It should be dried at 160° to 180° C. in the hot air chamber, and then weighed. The practice of drying this residue at 100° C. instead of 160° to 180° C. is in my opinion a mistake. I hold the same views with respect to determining the moisture at water-bath heat.

Were the latter assertion true, we should obtain on direct ignition, after the treatment in the water-bath, a result something like 4 to 5 per cent of organic matter in every sample of charcoal which we had occasion to analyse; but no charcoal contains this amount of organic matter (exceptional instances overlooked).

The oxide of iron, which is very constant in amount in new and old char, is best determined volumetrically by dilute standard solution of the potassic anhydro-chromate (Penny's process), or better by dilute standard solution of the potassic permanganate, using 0·5 grm. $KMnO_4$ in 1 litre distilled water; and the phosphoric acid may be determined with advantage by using a standard solution of uranium nitrate or acetate. Should chlorine be detected in any appreciable amount it is best determined volumetrically by standard solution of argentic nitrate and neutral chromate of potassium.

With regard to the moisture in new char, sugar-refiners are perfectly aware of its presence. The amount fluctuates between 5 and 10 per cent (dried at 160° to 180° C.), som times being as high as 15 per cent, and one sample whi

I had occasion to analyse, the mean of twelve experiments, yielded the enormous result of 20·42 per cent of useless water. True such char is sold at a reduction in price, but I hold that new charcoal can be manufactured without this useless water, but probably at an increase in cost. The fact is the days of these deceptions are numbered, and, in a scientific age, the sooner intelligent sugar-refiners demand their char with a reasonable amount of moisture in it (say 2 per cent) the better for all parties.

With regard to the organic matter in new charcoal, I have been particular and exact in determining this constituent in many samples of animal charcoal which I have had occasion to analyse. Indeed, the importance of the work usually entrusted to me will not allow me to overlook its presence, and, as the result of my examination, I have found it to fluctuate between 0·01 and 0·5 per cent; never more in new charcoal, and in the stock char of sugar refineries, where soft water is used, it is frequently as low as 0·001 per cent, and even this is only detected after grinding the charcoal to absolute dust. In regard to these figures I believe I have the coincidence of chemists, bone-char makers, and sugar-refiners, who really possess a considerable amount of authority on the subject.

The presence of this organic matter is a source of great annoyance to modern sugar-refiners. A portion of it dissolves in water and in acid, while the remainder is totally insoluble in either menstruum. It may be detected by the following tests:—

(*a*). Heat some of the dry char in a dry test-tube, inhale the fumes; should they smell of burning organic matter the inference is clear as to its origin.

(*b*). Separate all the matter soluble in distilled water, evaporate the solution in a platinum basin, raise the temperature; should the residue *blacken* it proves that the carbonaceous matter is in an incipient state of combustion. Soluble organic matter is indicated.

(*c*). Place some of the char on a watch-glass, underneath which is a circle of filter paper, run some strong dihydric sulphate over it. Blackening indicates the presence of organic matter.

(*d*). Filter the acid through asbestos previously washed with the same acid, should a very dark liquor filter through.

(*e*). If a portion of the charcoal be boiled with solution of caustic soda, and a yellow or brown solution is obtained, the presence of organic matter may be inferred.

Charcoal when new frequently contains considerable quantities of caustic lime and many other small constituents, which should on no account be omitted; and in all cases qualitative analysis should be resorted to previous to trying quantitative analysis, and even microscopy will perhaps lead to the discovery of substances entirely foreign to new animal charcoal, such as common coal, road sweepings, old charcoal from sugar refineries, associated with old charcoal dust and many other things.

Following up these adulterations it is the duty of the chemist to detect and estimate them if possible, and at all events to clearly prove they exist there.

(1). To commence with the detection of common coal in presence of animal charcoal. This may be detected with advantage by aid of microscopy, comparing the effect with standard coal and bone-black respectively, or with absolute certainty by the following ignition test. Place some of the suspected char in a platinum crucible with the lid on (a porcelain crucible is more preferable), heat somewhat strongly, and observe your subject.

(*a*) Volatile matter is given off,

(*b*) Which enters into rapid combustion,

(*c*) And burns with a yellow smoky flame.

(*e*) Leaves a carbonaceous deposit on the inside of the lid.

(*f*) The residue may *cake*.

(2). Road sweepings may also be detected by the appearance of the charcoal under an ordinary microscope.

(3). The adulteration of old charcoal with new, of which the former, which is absolutely useless for sugar refining purposes, and old charcoal dust, may be detected by the assistance of microscopy, or in the case of char dust by mechanical analysis and chemical combined.

Place some of the suspected char on a series of wire gauze sieves, such as are frequently used in sugar refineries in testing the division of charcoal, allow the dust to fall to the bottom of the apparatus, make a chemical analysis of both the charcoals, and ascertain their composition. This test is peculiar, because new animal charcoal and old spent material differ widely in their chemical composition, as also in their properties. The amount of carbon, water, iron, and alkaline salts, and organic matter are very constant in proportion in their respective samples, and tell at once whether the chars are identical. Thus new char does not contain more than 0·15 per cent of oxide of iron, whereas old charcoal contains as much as 0·30 per cent, and sometimes as high as 0·60 per cent. Again, the ash which a char leaves on ignition is a good indication of its age; thus new animal charcoal when genuine leaves a pure white ash; whereas old charcoal when ignited leaves a yellow or brownish ash, frequently cream coloured; and also the appearance of old and new char under a microscope can be distinctly distinguished. New charcoal is regular in division, and sharp round its edges, and black and velvety in appearance. Whereas old charcoal, from frequent revivification and manipulation in the sugar refinery, is confused and scattered in division, and broken and coarse round its edges, and has the appearance of time-worn stones. By these latter properties under the microscope it is easy to tell whether charcoal is mixed with old or stock char.

In working out these detections by means of the microscope the process will be highly facilitated by the help of standards. The presence of these frauds in animal charcoal is nothing new in connection with sugar refining, and I should only be too glad to add to my stock of information, so as to hold a position of advantage to detect and suppress them.

With regard to the amount of burning a charcoal should receive to meet the views of sugar-refiners, new foreign charcoal is often over burned, whereas home-made is as often under-burned; of both evils, the charcoal which is under-burned to a certain point, but not further, is to be preferred. Now when charcoal is over-burned the carbonaceous matter reacting on the calcic phosphate evolves free phosphorus; but in sugar refining, where upright revivifiers are employed, this seldom happens, the temperature being such as only to produce agglutination.

In sugar refining, where many samples of animal charcoal have to be examined to test revivification, it is indispensable that the method of bringing these samples to a rapid and also a very delicate test is of the highest importance both to sugar-refiners and also to chemists.

Having had frequently to keep pace with the revivifiers in a sugar refinery, I have found it an excellent test to find whether a specified char contains organic matter or not; if so the revivification process is scarcely complete, and should be repeated. The most delicate test which I know of, and which can be employed by any intelligent sugar-refiner, is—Place a *piece* of the charcoal under examination on the glass slide of a microscope and cover it with a *drop* of pure strong dihydric sulphate, allow it to stand for a short time, and then observe the effect through the microscope. Should organic matter exist in the char, even in the minutest trace, it will colour the acid brown, and the deeper in proportion. Many samples from the revivifiers may be tested in this way during a day.

These are facts in connection with the analysis and treatment of animal charcoal which are of the highest importance to chemists, and also to sugar-refiners who conduct their business on chemical principle, and are the observations of researches conducted for three consecutive years on the study of animal charcoal, both in the laboratory and in actual practice in the sugar refinery.

And, in conclusion, I regret that gentlemen connected with the Clyde sugar refineries, and elsewhere, rarely give scientific journals the benefit of their enlarged experience; still should any interested parties take up the subject for study, they will find it to be an endless band of chemical facts; the more it is studied the more curious it is to understand; and, moreover, science has not yet grappled the difficulties which are to be met with in its treatment on a large scale in actual practice.

DETERMINATION OF SULPHUR IN PIG-IRON AND STEEL.[*]

By Dr. THOMAS M. DROWN.

The method usually employed in accurate determinations of sulphur in pig-iron and steel is to treat a weighed sample of borings in a flask with muriatic acid, and to pass the gaseous products through an alkaline solution of lead or silver, which precipitates all the sulphur of the sulphuretted hydrogen in the form of sulphide of lead or silver. The sulphide thus formed is subsequently oxidised by aqua regia, bromine, or other oxidising agent, and the sulphuric acid formed precipitated in the usual way by chloride of barium.

I have substituted for the alkaline metallic solution, a solution of permanganate of potash in the strength of 1 gramme of permanganate to 200 c.c. of water, and find that it gives results quite as accurate as those obtained by using an ammoniacal solution of silver. By the employment of the permanganate, it will be readily seen, that there is a considerable saving of time and work. In order to test the accuracy of the method, six samples of pig-iron borings were weighed out (about six grammes each), and treated identically in the same way, with the exception that with three an ammoniacal solution of silver was used, and with the remaining three a solution of permanganate of potash. The sulphide of silver formed was filtered and oxidised by bromine water. The residues, after treatment with muriatic acid in the flask, were invariably filtered off and washed, then evaporated twice to dryness with aqua regia, taken up with muriatic acid, filtered, and the filtrate added to the main solution containing the sulphuric acid. In using the permanganate, I have found it necessary to avoid a very rapid evolution of gas. It is also necessary to pass the gas through at least three tubes or bottles containing the solution of permanganate. The gas then gives not the slightest blackening when passed into a lead or silver solution. After the evolution of gas has completely ceased, and air has been drawn through the apparatus for some time, the contents of the bottles are poured into a beaker, rinsed out with water, and any oxide of manganese adhering to the sides, or to the tubes, dissolved in a little muriatic acid. Enough muriatic acid is then added to the beaker to completely decompose the permanganate and convert it into a clear, colourless solution, in which the sulphuric acid may be directly precipitated. If the solution does not become perfectly clear, owing to impurities in the permanganate used, filtration is necessary before precipitation.

The following are the results obtained by the two methods:—

With Silver Solution.	Per cent.	*With Permanganate.*	Per cent.
No. 1	0·100	No. 4	0·093
No. 2	0·093	No. 5	0·098
No. 3	0·099	No. 6	0·091

The sulphate of baryta, after weighing, was fused with a little carbonate of soda and potash, and the sulphuric acid re-precipitated, giving—

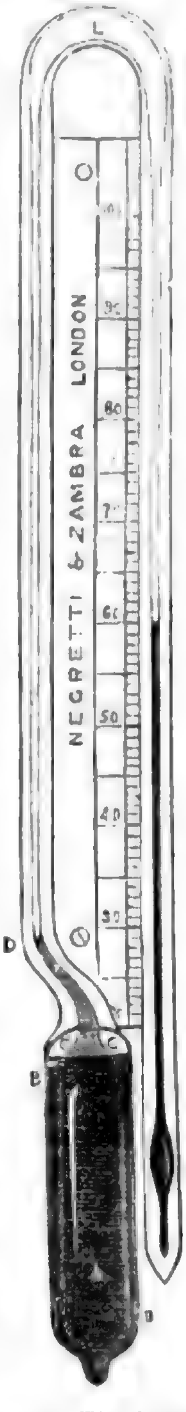
No. 1	0·0900	No. 4	0·0880
No. 2	0·0890	No. 5	0·0920
No. 3	0·0920	No. 6	0·0850
Mean	0·0903	Mean	0·0883

The difference in the two means is but 0·002 per cent.

The pig-iron used contained an unexpectedly small amount of sulphur. It was made from a brown hematite resembling a bog ore, occurring in vast quantities at Katahdin Furnace, Piscataquis County, Maine, containing 3 per cent of sulphuric acid.

NEW DEEP-SEA THERMOMETER.

Messrs. Negretti and Zambra have recently communicated to the Royal Society the description of a new Deep-Sea Thermometer. For the purpose of ascertaining the temperature of the sea at various depths, and on the bottom itself, a peculiar thermometer was, and is, used, having its bulb protected by an outer bulb or casing, in order that its indications may not be vitiated by the pressure of the water at various depths, that pressure being about 1 ton per square inch to every 800 fathoms. This thermometer, as regards the protection of the bulb and its non-liability to be affected by pressure, is all that can be desired; but unfortunately the only thermometer available for the purpose of registering temperature and bringing those indications to the surface is that which is commonly known as the Six's thermometer—an instrument acting by means of alcohol and mercury, and having movable indices with delicate springs of human hair tied to them. This form of instrument registers both maximum and minimum temperatures, and as an ordinary out-door thermometer it is very useful; but it is unsatisfactory for scientific purposes, and for the object which it is now used it leaves much to be desired. Thus the alcohol and mercury are liable to get mixed in travelling, or even by merely holding the instrument in a horizontal position; the indices are also liable either to slip if too free, or to stick if too tight. A sudden jerk or concussion will also cause the instrument to give erroneous readings, by lowering the indices if the blow be downwards, or by raising them if the blow be upwards. Besides these drawbacks, the Six's thermometer causes the observer additional anxiety on the score of inaccuracy; for, although we get a *minimum* temperature, we are by no means sure of the point where this minimum lies. Messrs. Negretti and Zambra have constructed an instrument on a plan different from that of any other self-registering thermometers. Its construction is most novel, and may be said to overthrow our previous ideas of handling delicate instruments, inasmuch as its indications are only given by upsetting the instrument. Having said this much, it will not be very difficult to guess the action of the thermometer; for it is by upsetting or throwing out the mercury from the indicating column into a reservoir, at a particular moment and in a particular spot, that we obtain a correct reading of the temperature at that moment and in that spot. The instrument has a protected bulb thermometer, like a syphon with parallel legs, all in one piece, and having a continuous communication, as in the annexed



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[*] A Paper read before the American Institute of Mining Engineers, February 28th, 1874.

figure. The scale of this thermometer is pivotted on a centre, and being attached in a perpendicular position to a simple apparatus (presently described), is lowered to any depth that may be desired. In its descent the thermometer acts as an ordinary instrument, the mercury rising or falling according to the temperature of the stratum through which it passes; but so soon as the descent ceases, and a reverse motion is given to the line, so as to pull the thermometer to the surface, the instrument turns once on its centre, first bulb uppermost, and afterwards bulb downwards. This causes the mercury, which was in the left-hand column, first to pass into the dilated syphon bend at the top, and thence into the right-hand tube, where it remains, indicating on a graduated scale the exact temperature at the time it was turned over. The woodcut shows the position of the mercury after the instrument has been thus turned on its centre. A is the bulb; B the outer coating, or protecting cylinder; C is the space of rarefied air, which is reduced if the outer casing be compressed; D is a small glass plug, on the principle of Negretti and Zambra's patent maximum thermometer, which cuts off, in the moment of turning, the mercury in the column from that of the bulb in the tube, thereby insuring that none but the mercury in the tube can be transferred into the indicating column; E is an enlargement made in the bend, so as to enable the mercury to pass quickly from one tube to another in revolving; and F is the indicating tube, or thermometer proper. In its action, as soon as the thermometer is put in motion, and immediately the tube has acquired a slightly oblique position, the mercury breaks off at the point D, runs into the curved and enlarged portion E, and eventually falls into the tube F, when this tube resumes its original perpendicular position. The contrivance for turning the thermometer over may be described as a short length of wood or metal having attached to it a small rudder or fan: this fan is placed on a pivot in connection with a second; on the centre of this is fixed the thermometer. The fan or rudder points upwards in its descent through the water, and necessarily reverses its position in ascending. This simple motion, or half-turn of the rudder, gives a whole turn to the thermometer, and has been found very effective. Various other methods may be used for turning the thermometer, such as a simple pulley with a weight which might be released on touching the bottom, or a small vertical propeller which would revolve in passing through the water. Messrs. Negretti and Zambra have also adopted a very simple and inexpensive clock-work to their thermometer, and by these means an observer may have a record of the exact temperature at any hour of the day or night. We need hardly say of what utility the instrument will prove to meteorologists, and even manufacturers, to whom an exact *record* of temperature is of importance. Hitherto we have had no simple and inexpensive instrument adapted for this purpose: the thermograph in use at most observatories is an elaborate and expensive apparatus, which, in connection with photography, will record on paper the temperature during day or night; it necessitates the use of gas, or any artificial light, and of course is only available to persons who can have a building specially adapted for it.

PROCEEDINGS OF SOCIETIES,

NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE.

February 12th, 1874.

His Excellency Governor **Archibald** in the Chair.

The Annual *Conversazione* of the Nova Scotian Institute of Natural Science was held on February 12th, at 7.30 p.m., when a large and fashionable assemblage filled the Long Room and other apartments of the Custom House, the Inland Revenue Offices, the Geological Museum, and other rooms of the New Provincial Building, Halifax, N.S. The following programme was carried out:—

(1). Dissolving Views Illuminated by the Oxyhydrogen Light. By Drs. De Wolfe and Warren.
(2). The Sea-Abyssal Zone. By Dr. Honeyman, F.G.S.
(3). Observations upon the Bones of a Fossil Whale found lately in New Brunswick, with restorations. By Dr. B. Gilpin, President.
(4). Music.
(5). Recreations in Natural Philosophy; chiefly Experiments on Air. By the Rev. Dr. Warren.
(6). Chemical Relations of Heat. With experiments. By Professor Lawson, Ph.D., LL.D., Dalhousie College.
(7). Promenade and refreshments.

The only address coming within the range of subjects embraced by the Chemical News was that of Professor Lawson. It was devoted to some of the Chemical Relations of Heat.[*] He explained the nature of heat as a form of force, co-relative with light, mechanical energy, electricity, magnetism, and chemical affinity, showing that the one was convertible into the other. These forces influenced matter; upon the varying degrees of heat depends the condition of matter, whether it exists as a solid, a liquid, or a gas. Water is solid at low temperatures; when we give it more heat, raising the temperature to 32°, it becomes a mobile liquid; if the temperature be raised to 212°, the water has its condition changed to that of an invisible gas, which we commonly call "steam." As soon as the excess of heat above 212° is removed, the gas (or steam) passes back into the liquid state, and then, if further reduced (below 32°) into a solid, which is the present condition of all water in the open air in this part of the world, except in the deep sea and in deep lakes, &c., where it has not been cooled down to that temperature (in all still waters, however, a foot or two at the surface forms our ice-bridges and skating-ponds).

Illustrations were given to show that when a liquid passes into a gaseous state it absorbs heat, which it necessarily takes from surrounding bodies and makes them cold. Ammonia, ether, alcohol, vinegar, all readily volatilise, pass into the gaseous state; and the absorption of heat, to enable them to do so, necessarily produces a sensation of cold on the skin. The most remarkable body shown was sulphur dioxide, which, when poured on the back of the hand, evaporates instantaneously, produces intense cold, and freezes the flesh if used in too great quantity. The freezing of the hand in this way presents all the uncomfortable and dangerous symptoms of natural freezing at an excessively low temperature in an extreme climate. The evaporation of sulphur dioxide *in a current of air* produces a still lower temperature, freezing mercury, which does not solidify till the temperature goes down below 39° below zero. All these temperatures are of the Fahrenheit scale, the only one known in Nova Scotia except in scientific laboratories, where the Centigrade system is coming into use, and must in time prevail.

Professor Lawson entered into a full description of sulphur dioxide, which is always produced as a gas when sulphur is burned in the air or oxygen; it is also produced in the burning of coals containing pyrites or sulphide of iron, and by coal gas when it contains sulphur compounds; and the wilting of house plants, and probably the occurrence of coughs and colds in winter, are to some extent due to its occurrence in sitting rooms. Its old name is sulphurous acid gas. It is known also by the names of sulphurous oxide, sulphurous anhydride, &c., but everyone is familiar with it by smell, as that of the "smell" of burning sulphur. The Professor did not wish to burn sulphur just at present, as the audience might soon have enough of the fumes. [The audience obviously misunderstood this remark, and His Excellency enquired whether it was meant as a compliment to the company that they would all smell sulphur soon enough; but the Professor explained that his remark referred only to the fumes of this evening.] He went on—The gas extinguishes flame, and the burning of sulphur is a common remedy for extinguishing a fire in the chimney. However, several metals will burn in the gas, decomposing it—as, for example, potassium, which forms polysulphide, sulphate, and thiosulphate; when simply heated to about 2200°, it is decomposed into free S and O. It has decided bleaching-properties, and is used for wool, silk, sponge, isinglass, and other animal substances that would be injured by chlorine; also for straw hats and willow baskets. A solution of the gas will remove fruit stains and wine stains from linen. It acts as a disinfectant, an antiseptic, and has been used in preserving meat; it is also an arrester of fermentation, on account of which wine and beer casks are sulphured, and sulphites are used in breweries and sugar factories. It preserves vellum and catgut. One of its most remarkable effects is that produced by its inhalation; it is not only irritating, like hydrochloric acid gas, and suffocating, like chlorine; but, when inhaled in a concentrated form, it *immediately* produces catarrh and sore throat, with all the ordinary symptoms of the natural malady, from which both the Professor and his assistants (Messrs. Lindsay and Stewart, medical students) had suffered more or less during successive investigations.

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[*] "On some of the Chemical Relations of Heat, illustrated by Experiments on the Effects of Heat on Water and on Sulphur Dioxide." By George Lawson, Ph.D., LL.D., Professor of Chemistry, Dalhousie College and University, Halifax, N.S.

The gas is 2¼ times the weight of atmospheric air (sp. gr., 2·25). It is very soluble in water, which absorbs about 40 times its bulk of the gas at ordinary temperatures; the solution, when exposed to air in a bottle, changes slowly to solution of H_2SO_4. At low temperatures a crystallised hydrate of sulphurous acid is obtained. In preparing the gas for condensation, the tubes must be kept dry, otherwise this hydrate forms in them and stops them up. At zero F., which may be readily attained by a freezing mixture of old frozen snow and salt (newly-fallen snow does not answer well, the sulphur dioxide gas is easily condensed to a liquid, which (at 60°) is 38 per cent heavier than water (sp. gr. = 1·38). The boiling temperature of this liquid, however, is 14°, and when in sealed tubes (if the temperature be raised to 60°, that of ordinary air) it exerts a pressure of 2¼ atmospheres. At between 105° and 110° below zero the liquid freezes into solid crystals, which are heavier than the liquid. A tube of the sulphur dioxide was placed on the hand of His Excellency the Lieutenant Governor, when the liquid immediately began to boil. Tubes were then handed round the room, so that every one might see the boiling by the heat of the hand. One lady succeeded so well in the boiling that, to her consternation, the tube exploded, and the cork was thrown in the air as from a pop-gun. To succeed perfectly in showing the boiling of the liquid dioxide by heat of the hand, it is necessary to have a twist of cotton, enveloping freezing mixture, around the top of the tube, to provide for rapid condensation; or the tube may be fitted with an encircling short piece of much wider tube at top to contain the freezing mixture.

The next experiment was a very remarkable one. A platinum crucible was made red-hot, the dioxide was thrown into the spheroidal state, water was added, and the red-hot crucible became filled with ice—the whole having cooled down in half a minute from red heat to a temperature far below freezing, and under favourable circumstances it would reach 40° below zero, so that even mercury could be frozen. This simple but striking experiment excited so much interest that after the close of the regular proceedings it was repeated over and over again to successive groups, who wished to watch closely the remarkable effects produced, and to handle the frozen crucible that had been red-hot within the same minute, and was cooled down in a warm room by simple evaporation over a spirit-lamp flame.

Professor Lawson, in referring to the great opportunities which we have in this climate of studying the effects of heat, exhibited a large bottle containing several pounds of glacial sulphuric acid that had separated and crystallised spontaneously from a solution of ferrous sulphate in oil of vitriol during the recent severe weather. The small portion of solution left in the bottle had a sp. gr. of 1·619.

At half-past nine the reading of the papers was completed, and the company dispersed to the various rooms, some in quest of the mineral and fossil departments, some to the tea and coffee rooms, some to the microscope and glass jars containing the tribute left by the *Challenger* on her visit to Halifax, and others in search of the bones of the fossil whale. The meeting was a very successful one, and has excited some scientific interest in the general community.

NOTICES OF BOOKS.

Journal of the Chemical Society. Containing the Papers read before the Society and Abstracts of Chemical Papers published in other journals. Edited by Henry Watts, B.A., F.R.S. London: J. Van Voorst. 1874.

Index to the First Twenty-five Volumes of the Journal of the Chemical Society, 1848-1872; *and to the Memoirs and Proceedings*, 1841-1847. Compiled by Henry Watts, B.A., F.R.S. London: J. Van Voorst. 1874.

The Chemical Society of London has entered upon the fourth year of an enterprise unique, as far as we know, in the annals of a scientific society, and deserving the support of everyone connected with chemistry. The monthly Journal now contains, in addition to the papers read before the Society, abstracts of the chemical papers published in England, America, and on the Continent. Fellows of the Society, or annual subscribers of one guinea, are not only thus relieved from the necessity of taking in a large number of journals in order to ascertain what is being done in any department of chemistry, but they have the matter of the chemical communications placed before them in a condensed form. To those with but little spare time, or unacquainted with foreign languages, this is a great boon. The last annual volume may be taken as an example of the bulk which this valuable material occupies. We find that it contains nearly 1300 pages, of which by far the greater number are taken up by the abstracts, which amount to about 1400. These abstracts are prepared by some two dozen Fellows of the Society, aided by the Editor and a committee of publication.

We may state that technical chemistry comes in the second place as to the number of subjects treated of, the first place being occupied by organic chemistry; then follow papers on analytical, mineralogical, physical, inorganic, physiological, and agricultural chemistry. Our American and manufacturing readers will especially appreciate the usefulness of such a work. The expense of publication is very considerable, and is at present largely borne by a guarantee fund raised among the Fellows of the Society. The British Association has recognised the great value of this work by making a yearly grant of £100 towards its expense.

The Index to the Journal since its first issue in 1841 will also be found a most useful work, referring as it does to a period of such great activity in chemistry. Mr. Watts has not confined himself to a bare arrangement of titles, but has also referred, in many cases, to the different sections of the papers.

The Worthies of Cumberland. By H. Lonsdale, M.D. London: G. Routledge and Sons.

This work contains biographies of Wordsworth, the Blamires, Thomas Tickell, Dr. Thomas Addison, the Loshes of Woodside, and Hugh Lee Pattinson. The two last-mentioned names will chiefly attract the attention of our readers. John Losh may be regarded as the forerunner of the alkali manufacture on the Tyne. In conjunction with Earl Dundonald—the father, we presume, of the great admiral—he established alkali works at Bell's Close, near Newcastle, struggling manfully against the salt excise and its inconveniences. His brother, William Losh, took up the unfinished task, and lived to see the alkali trade of the north assume its present gigantic proportions—the result, in no small degree, of his skill, perseverance, and energy.

James Losh, another brother, afterwards Recorder of Newcastle, was mixed up in the controversy concerning the discovery of the safety-lamp. Sir Humphrey Davy wrote him a very peppery letter for having joined in presenting a service of plate to his rival, Stephenson.

The most remarkable and valuable memoir in the book, however, is that of Pattinson, the inventor of the world-famed process for separating silver from argentiferous leads, and otherwise one of the most able and successful practical chemists the world has ever seen; witness his oxychloride of lead, his improvements in the preparation of magnesia, his investigations on the electricity of steam, and his explanation of the Gateshead explosion.

We can most cordially recommend this work to all who feel an interest in the history either of applied science or of literature. Extracts numerous and interesting might easily be given; suffice it to say that, in addition to the subjects of his biographies, the author brings us in contact with Davy, Humboldt, Faraday, Stephenson, Dundonald, Coleridge, Jeffrey, Paley, and many other men of mark of the last century and the earlier half of the present. One circumstance strikes us, however, as remarkable:—The life of John Dalton has, indeed, been adequately written, still it is curious to find him entirely omitted in an enumeration of the worthies of Cumberland.

Fruits and Farinacea: the Proper Food of Man. By the late John Smith, of Malton. Edited by Emeritus Professor Francis W. Newman, for the Vegetarian Society. London: F. Pitman, Paternoster Row. 1873.

We do not know whether vegetarianism be on the increase, and we cannot imagine that Mr. Smith's book will bring it more into vogue; for, although he attempts to prove that vegetables were the "original" and the "natural" food, and still constitute the "best" food of man, his arguments and proofs are in the main so unsatisfactory, that we are more inclined than ever to be omnivorous. The proof that vegetables were the original food of man are mainly taken from Genesis, Ovid, Pope, and Thomson; Hippocrates and Galen (who are called "eminent physicians") are quoted as authors of the statement that all early races "were perfectly natural and simple in their diet." Of course, before fire was known, man in his crudest and most barbaric state was compelled to live on the fruits of the earth, or on raw flesh, but we have no wish to go back to that state of semi-gorillaism.

If our author desires an ancient account of man in this early period, we refer him to Lucretius ("De Natura Rerum," lib. v., 930 *et seq.*), where he will find an account of the fruit-loving race. The earth, says Lucretius, then furnished plenty of whortle-berries, larger than those which now grow, upon which men lived, together with acorns and fine crab-apples; but the conditions and the mode of life there delineated is in good sooth anything but enticing. The men who lived on fruits, lived in caves, and clothed themselves with the untanned skins of wild beasts, when they could get them.

Next, our Author gives us the evidence from comparative anatomy to prove that man is not a flesh-eating animal. He assures us that our teeth are not adapted for the purpose: that in reality we have no pointed canine-teeth in our head, although we give them that name. Other arguments are drawn from our zygomatic arch, alimentary canal, stomach, colon, and cœcum, liver, and perspiratory glands. In effect, he endeavours to show that we resemble the herbivora in the following respects:—

(*a*). In the absence of claws and tusks.
(*b*). In the joint of the lower jaw.
(*c*). In the form of the cheek-arch.
(*d*). In the considerable length of alimentary canal.
(*e*). In the size and complexity of the other digestive organs.
(*f*). In the number of the perspiratory glands.

Many other arguments, for the most part very irrelevant, are adduced in favour of a vegetable diet. In the comparison of the food of an Esquimaux with that of an Arab, no mention is made of the fact that the temperature of the blood of the former is the same as that of the latter, while the cooling causes are infinitely greater and the food requires to be adapted to the differences of climate. Some experiments are quoted in which men were fed daily on 2 lbs., 3 lbs., and 1 lb. respectively of potatoes for breakfast, dinner, and supper. We are not told how long the experiment was continued, but eight out of the ten men experimented upon gained weight, which is, perhaps, not to be wondered at when we remember that they were confined closely and had very light work to do. In another experiment, men were fed upon oatmeal, buttermilk, and potatoes; their work was very light, and we cannot wonder at the fact that they gained weight. But we should like to know how it was gained, or rather where the gain took place, and what was the condition of their muscles.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—In commercial analysis it is, I suppose, unavoidable that discrepancies should often occur between the results of the chemist for the buyer and those of the chemist for the seller. But even if this be the case it is well, perhaps, that when an analysis which appears absurd in itself is tendered in return for a fee, that the analyst should be invited to explain his results or refund the fee. A case in point has lately occurred, and as, after two applications for an explanation of the analysis, I have failed to obtain anything satisfactory, I now ask you to favour me by publishing the case, in the hope that some brother chemist may either supply the needed light to elucidate the results bought, or strengthen my own opinion of their inaccuracy.

A short time back some spent char was placed in my hands for analysis, a sample being also sent to a local chemist. The percentage of phosphate of lime only was required, and inasmuch as my own result was more than 2 per cent higher than that obtained by the buyer's chemist, a portion of identically the same sample was, by my request, sent to London to be analysed by a gentleman well known as having great experience in the examination of phosphates. The results of all three operators I append. No. 1, analysis by London chemist. No. 2, provincial chemist. No. 3, my own analysis.

	I.	II.	III.
Water and organic matter	17·50		18·4
Phosphoric acid	*32·83	73·9	†34·9
Lime	44·10		41·9
Oxide of iron and alumina	—		0·8
Magnesia, carbonic acid, &c.	3·47		2·22
Insoluble siliceous matter	2·10		1·20

* Equal to tribasic phosphate of lime, 71·67
† „ „ „ „ 76·2

Now, Sir, setting my own results aside, and ignoring the estimation of phosphate of lime made by the local chemist, because it is an estimation of phosphoric acid only, I set seriously to considering the results offered by the London gentleman. Phosphoric acid when saturated with lime is known to form a compound in which acid is to base as 71 : 84. And if we take the amount of phosphoric given in this analysis we shall find it will require 38·84 per cent of lime to form this compound. The total lime stated, uncombined with carbonic acid, is 44·1 per cent; thus there appears an amount of 5·26 per cent lime uncombined or combined with some organic acid. The substance is not alkaline to test-paper, hence the lime is not uncombined, and if the carbonic acid be estimated after ignition, and heating with ammonia carbonate, no increase of carbonic acid is found, hence the lime cannot be combined with an organic acid. The question is of some importance because it has become greatly the custom with analysts to report in phosphates an excess of lime, which does not show itself either by alkalinity of the ignited phosphate, or by an amount of carbonic or other acid sufficient to justify the statement that it is present.

If any of your readers could explain how the analysis No. 1 can, under the circumstances, be correct, and would kindly take the trouble to do so, I should feel much indebted.—I am, &c.,

Edmund A. Cook.

12, Norwood Grove, W. Derby Rd.,
Liverpool, April 28, 1874.

VALUATION OF SALT-CAKE.

To the Editor of the Chemical News.

Sir,—Mr. Wm. Simmonds seems to have mistaken my object in communicating what I did to the Chemical News regarding salt-cake valuation. I only said it was the plan followed in a great centre of its manufacture, and hence some of the discrepancies observed in its analysis. I am perfectly aware that the process is far from perfect; but when I state that it is no uncommon thing for a chemist or his assistant to have ten or twelve samples of salt-cake to do *directly*, besides other work, it will be seen that it would be impossible to make an analysis such as Mr. Simmonds gives us for reference.—I am, &c.,

R. J. Tinniswood.

Radcliffe, near Manchester,
May 2, 1874.

ON THE CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

To the Editor of the Chemical News.

Sir,—I observe in the current number of your journal a paper by Mr. Ogilvie, in which he makes some statements which, to my mind, require some slight correction.

The method he prefers to adopt to obtain comparative results I do not purpose to criticise, seeing that these methods are but vague at best, and any mode of proceeding that may be adopted is useful for comparison; what I would do, however, is to correct the dogmatic statements which Mr. Ogilvie makes, and which I am sure he would not have done had he carefully considered some of the points to which I will now refer.

In the comparative table on page 182 it is stated that the "alcoholic extract" includes "creatin, inosic acid, lactic acid." Now creatin and inosic acid are not soluble in cold alcohol, and nearly insoluble in hot, and creatinin and sarkosin act in the same manner, so that these bodies would be in the "watery extract." In this last mentioned extract gelatin is included; was it a hot or cold extract, and as the numbers are so high for Liebig's extract was there any gelatin in the sample analysed?

Lower down the list we have the proportions of "fibrin or syntonin." Fibrin is an insoluble form of albumen undoubtedly, but syntonin is an acid-albumen obtained in a very different manner, and is soluble in dilute mineral acids.

There is no justification for the statement—"Thus fat is not only indispensable in the process of repair of all cellular and fibrous matter, but is also necessary for the digestion of the other elements of food," for herbivorous animals take but little fat in the food they eat, yet they convert starchy matters largely to fat. And, again, seeing that the more important and greater part of the body is not "cellular or fibrous" it cannot matter whether fat is necessary for the repair of those tissues, though it is well known they neither of them contain fat.

A few lines below this the following expression occurs:—"As without them (the salts) the other bodies could not be ingested." How the absence of salts can affect ingestion I do not know; to ingest means to put into the stomach.

Further on Mr. Ogilvie falls into a greater error yet, or perhaps he has been misinformed on the subject. He compares the jelly of preserved mutton and Liebig's extract of meat with tea and coffee as nerve stimulants. He says they contain an alkaloid (?), creatin corresponding in chemical relationship with theine and caffeine. This is quite incorrect; in Strecker's researches on this matter the constitution of these bodies could not be harmonised, although it was thought possible they might belong to an homologous series, even when decomposition did not yield the same results.

These bodies—creatin, uric acid, urea, and lactic acid—are undoubtedly waste products of the animal economy. The fact that they occur in the urine in health shows that they are waste material, and their presence in muscle is merely an evidence that they are constantly in process of conversion, and of course are necessarily always to be found.

So far from exciting mental activity, urea and creatin produce coma, and lactic acid produces variously, if in excess, rheumatism, rickets, or mollities ossium.

That extract of meat is beneficial is still an unsettled point. Bogoslowsky (*Arch. f. Anat. u. Physik*, 1872, 347, 421) give some experiments on this subject, in which warm water acted in exactly the same way as extract of beef solution; and that large doses of extract killed the animal as did water containing the same proportion of mineral matter as the extract.

Apart from scientific evidence there can be no doubt that Australian preserved mutton is an excellent food. It is largely used in asylums, prisons, and workhouses, the inmates of which undoubtedly preserve their health and strength in a remarkable manner.

I trust that Mr. Ogilvie will regard these criticisms as they are meant, as a courteous explanation of errors, the which should always be corrected.—I am, &c.,

S. W. Moore.

Physiological Laboratory,
St. George's Hospital, S.W.
April 30, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 16, 1874.

Note on the Employment of Flexible Laminæ for Tracing Arcs of a Circle of Large Diameter.—M. Resal.

Experimental Researches Leading to a Determination of the Temperature of the Sun.—P. Secchi.—The author sought to compare the solar radiation with that of the electric light. He used the thermheliometer described in his work on the Sun. It is difficult to determine the surface of the radiating parts of the carbons, and he endeavoured to do so by comparing their dimensions with those of glass tubes placed very near, and estimating the distances at which a platinum wire entered into fusion without touching them. Thus, a surface nearly rectangular was got, and the radiation of parts exterior to this limit was cut off by diaphragms. The temperature produced by solar radiation was determined about midday on several days in July, and with the same instrument. The difference was found 17·16°, or, with correction for atmospheric absorption, 17·37°. Substituting this in the formula, the solar radiation is given as thirty-six and a half times that of the carbon points. This estimate, however, is considered under the truth; and if we take M. Soret's direct estimate (on Mont Blanc) of 21·13° instead, then, supposing the temperature of the radiating surface of the carbons 3000° (which is not exaggerated), and supposing the radiation proportional to the temperature, we get, for the potential temperature of the sun, 133,780°. This might be even raised to 169,980°, if the figure of 27° were taken as produced by solar radiation. If the temperature of the sun reaches only some thousands of degrees, his cooling should be sensible in a comparatively short time, and the diminution of temperature should lead to a notable acceleration of the stars' radiation.

Report on Geodesic Works Relative to the New Determination of the Meridian of France.—M. de Beaumont (in name of Commission).—It is hoped, by completion of the work now in hand, to obtain the measure of an arc of meridian, which from the Shetland Islands to the Great Desert of Sahara will embrace more than 26° of latitude. This will furnish, for determination of the size and figure of the earth, a more extended base than any used hitherto.

Memoir on the Swimming-Bladder as regards Station and Locomotion of the Fish (continued).—M. Moreau.—A perch contracted (in volume) momentarily on a shock of electricity being given to it. It can also diminish its volume voluntarily; when making an effort, *e.g.*, to pass an obstacle. Such contractions are only of short duration, and are probably not utilised by the fish to change its density, and favour its movements of ascent or descent. The swimming bladder confines the fish in a zone, the middle of which corresponds to its normal volume, to that which the density of the water gives it. The bladder is a permanent source of danger to the fish. In fishing for whiting pont (*Gadus barbatus*) with a line not more than 2 to 3 metres long, the author found that all the animals brought up had their bladders ruptured.

Conditions Determining the Movements of Grains of Chlorophyll in the Cells of *Elodea canadensis*.—M. Prillieux.—The author distinguishes between movements, on which light has influence, in the intact plant, and other movements produced through lesion of the tissues. He thinks that the most natural way to explain the facts of observation is by supposing that the grouping of grains of chlorophyll is determined by attractions which they exert on each other, and which the membranes exert on them.

Laws of the Plane Distribution of Pressures within Isotropous Bodies in the State of Limited Equilibrium.—M. Boussinesq.

Friction of Glaciers and Erosion of Valleys.—M. Ch. Grad.—The author gives reasons for thinking that neither the valleys of the Alps, nor the lakes of Italy and Switzerland, nor the fiords of Norway and Greenland owe their origin to erosion by glaciers.

Symetric Isomerism, and on the Four Tartaric Acids.—MM. Berthelot and Jungfleisch.—The union of dextro-tartaric and lævo-tartaric acids to form the optically neutral acid in a solid state liberates +4·43°. The mixture of the two acids in solution sets free only +0·12°. It appears probable that these two acids remain almost entirely separate in their dilute solutions, and that water decomposes in great part the neutral acid into its two acid constituents.

Crystalline Hydrates of Sulphuric Acid.—M. Berthelot.—The author has been engaged, during the past winter, with preparing a large quantity of the second crystalline hydrate of sulphuric acid. The large brilliant crystals were drained for eight days on a plate of biscuit-porcelain, and the heat developed during their solution was then determined. In presence of 200 H_2O_2 three experiments gave a mean of 3·56 at the temperature of 11·5°. The heat given off by the same acid melted, at the same temperature, and in presence of the same amount of water was 5·40. Hence the heat of fusion of the bihydrated acid, $SO_4H,HO = 1·84°$.

Heat of Combustion of the Varieties of Red Phosphorus.—L. Troost and P. Hautefeuille.—The appearance of red phosphorus depends on the highest temperature to which it has been exposed. If prepared at 265°, it forms splendid red masses, with a vitreous fracture like that of realgar. If prepared at 440° it is of an orange shade, and its fracture is dull and granular. Above 500° it becomes more compact, and has a bright violet-grey colour. That obtained at 580° has a conchoidal fracture, and in thin layers it appears semi-transparent. Crystallisation commences in ruby-red particles, which recall the geodes of hyaline quartz found in agate. The specific gravity and the heat of combustion vary in a continuous manner in specimens formed at gradually increasing temperatures. The kind prepared at 265° has the specific gravity 2·148, and its seat of combustion exceeds that of common red phosphorus by 320 calories per grm. Red phosphorus obtained at 360° has the specific gravity 2·19, and its heat of combustion exceeds that of the crystalline red variety by 298 calories. That formed at 500° has the specific gravity 2·293, and its heat of combustion is still higher than that of the crystalline kind. That obtained at 580° has a heat of combustion lower than that of the crystalline red variety by 50 calories.

Chemical Nature of the Sulphide of Iron (Troilite) contained in Meteoric Irons.—Stan. Meunier.—The author contests the view of Lawrence Smith that troilite is a simple proto-sulphide of iron, and regards it as a variety of Breithaupt's pyrrhotine, Fe_7S_8. This opinion is founded on the results of the analysis of several troilites submitted to a previous purification. As a confimatory test he finds that while a cold aqueous solution of the sulphate of copper is instantly reduced to metallic copper by the proto-sulphide of iron, troilite, like pyrrhotine, remains entirely unattacked under the same circumstances. Jannetaz has shown that in contact with an aqueous solution of the bisulphate of potash, proto-sulphides, such as galena, blende, &c., give off sulphuretted hydrogen, whilst nothing similar ensues if the sulphide has a different constitution. Treated in this manner proto-sulphide of iron gives off sulphuretted hydrogen, whilst with troilite no odour can be perceived.

Phosphate of Cerium containing Fluorine.—Radominski.—This paper has been already noticed.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 4, April, 1874.

Report made by M. Salvetat, in the **Name of the Committee of Chemical Arts, on the Procedures for Weaving and Dyeing the so-called Lisieux Cloths, introduced by M. Theophile Grison, of Lisieux.**—The description of the processes presents nothing definite. It is stated as a novelty that M. Grison had the idea of mixing with woollen refuse new greased cotton. "It is evident that oiled cotton acquires properties equivalent to those of this fibre when animalised." The cotton does not form the warp of the cloth, but is carded with the wool and spun together.

Discourse on the Modern Progress of Chemical Manufactures.—M. Aimé G[illegible]rd.—This lecture was delivered in 1873 at the Lyons meeting of the French Association for the Advancement of the Sciences. The principal points have been already noticed in the Chemical News.

Bulletin de la Societe Francaise de Photographie, No 2, February 1874.

At the meeting of the Society, February 6, it was stated that red glass was preferable to yellow for the windows of photographic ateliers.

History of the Preliminary Insolation of the Sensitive Layer.—M. Perrot de Chaumeux.—Gaudin, continuing the action of light upon a Daguerre's plate, by means of a screen of red glass obtained in a high wind images of clouds near the zenith in half a second. No accelerating substances were then known. A few weeks afterwards Becquerel, continuing his researches, found that yellow light was much superior to red upon sensitive paper. About the same time Fortier Senior obtained instantaneous proofs on operating in a camera the sides of which were of yellow glass. In 1843 Becquerel published the following passage:—"If we spread chloride of silver upon white paper, or upon any surface, and expose it in the spectrum, we see a reaction set in towards the extreme violet between the lines H and G of Fraünhofer, and extend on the one hand almost as far as F in the blue, and, on the other, far beyond the visible violet. But if the chloride of silver, after having been prepared in a perfectly dark room, is exposed for a short time to diffused or solar light, so that it may not be blackened, but that merely a very slight commencement of action may take place, and if it is afterwards exposed in the spectrum we see a colouration not only in the extreme violet, but an action appears at the same time in the least refrangible part of the spectrum towards the extreme red. Becquerel shows in the same memoir that the bromide, iodide, and, in general, all salts of silver undergo the same reactions. The discovery of accelerating substances drew away the attention of experimentalists from the practical application of these facts. We find, however, in a treatise on photography upon paper, published by M. Blanquart-Evrard in 1851, a chapter on the use of a camera whitened within. He declares that by this means the susceptibility of the plates can be increased more than one-half. In 1870 Constant recommends the use of a camera partially whitened within, according to the use for which it is intended. Bazin obtained an acceleration of one-third in time by introducing red light into the camera by means of a special aperture. Léon Foucault exposed his sensitised plates to the light of a Carcel lamp before placing them in the case. The employment of green light has been lately found very useful for the same purpose.

Second Note on Heliochromy.—M. de Saint-Florent.—If a sheet of paper, prepared with subchloride of silver as described below, and freed by washing from excess of hydrochloric acid, is placed behind a painting on glass, we obtain, after a short time, a negative proof presenting all the colours of the original. This image becomes positive if the exposure is prolonged. The paper is prepared by immersing good common paper in an alcoholic bath of nitrate of silver, prepared as follows:

Distilled water	20 parts.
Nitrate of silver	20 ,,

When the solution is complete, add—

Alcohol	100 parts.
Nitric acid	10 ,,

When taken out of this bath the paper is dried in a quire of blotting paper, and steeped in—

Hydrochloric acid (strength ?)	50
Alcohol	50
Nitrate of uranium	1
Chloride of zinc	2

In this bath the paper is left for some minutes, and exposed to light till it takes a violet-blue tint.

Gazzetta Chimica Italiana, Anno iv., Fascicolo 1 and 2, 1874.

Studies in Toxicological Chemistry.—Prof. Francesco Selmi.—An examination of the reactions applicable for the detection of solanin and solanidin; of the methods for extracting organic alkalies from the viscera, and for detecting nicotin, brucin, and strychnin; and of the recognition of hydrocyanic acid.

Old and New Reagents for Common Phenol.—Egidio Polacci.—The author points out the distinctions between the blue colour produced by phenol and hydrochloric acid with a chip of fir-wood and that given by hydrochloric acid alone. The violet colouration given by perchloride of iron is indecisive as being common to all the phenols. The blue colouration given by the successive action of ammonia and a hypochlorite is less general. As this method turns on the conversion of the phenol into aniline by the action of ammonia, the test is only available where the absence of aniline is satisfactorily demonstrated. Cresylic acid and thymol yield similar results. In complex organic fluids the reaction may fail. The conversion of phenol into picric acid by the action of nitric acid cannot be used for the detection of the first mentioned body, since the same result is obtained with a great variety of bodies. The author pours into a narrow test-tube concentrated sulphuric acid to the height of 4 or 5 centimetres, and adds cautiously the aqueous solution containing the phenol, in such a manner that the two liquids may not mix. A formation of three colours is soon perceived at the line of contact of the two liquids. These three are soon reduced into one, a vermillion-red, which, setting out from the plane of division diffuses itself through the entire mass of the phenol solution. This colour is stable, and remains unaltered for months. If the red liquid is removed from the acid, and treated with an alkali, it becomes yellow without losing its transparency. This reaction serves to detect 1 part of phenol in about 2000 of water. Another method is as follows:—In a well glazed porcelain crucible is put a little of the most concentrated sulphuric acid, to which is added a relatively minute portion of bichromate of potash. The mixture is well stirred so that the liberated chromic acid may be uniformly distributed through the sulphuric acid. A small drop of the liquid under examination is placed upon the acid mixture, which immediately gives a brown colouration at the point of contact. If the proportion of phenol is larger than 1 part in 30,000 the colouration is accompanied with a chocolate-brown precipitate. The author has also examined Landolt's test, which consists in adding to the suspected solution bromine water in slight excess. If phenol is present a yellowish white precipitate is produced. The sensibility of this reaction extends to 1 part in 45,500. As Landolt has remarked, precipitates, more or less similar, are produced by oxybenzoic acid, the homologues of phenic acid, anilin, toluidin, quinin, quinidin, cinchonin, strychnin, narcotin, and morphin. The author considers that the yellowish white precipitate may be recognised as tribromo-phenol by the following reactions:—It has a special odour, slightly recalling that of the hydride of salicyle. It is insoluble in acids, but soluble in alkalies, ether, and absolute alcohol. A very small quantity of water completely separates tribromophenol from its alcoholic solution. If carefully heated on platinum-foil it may be volatilised unchanged without leaving a residue. But if the heat is strong the compound is decomposed and burns with a smoky flame, evolving much bromine, and leaving a carbonaceous residue. A portion placed in a porcelain capsule, and treated with sulphuric acid and bichromate of potash, produces a chocolate-brown colour, with the escape of bromine vapours. If the bichromate is dissolved in water, and the experiment conducted in a glass tube, with the application of heat, the liquid takes a fine green colour. If gently heated with nitre and concentrated sulphuric acid, it forms oily drops of a fine red colour, which burn, leaving a bulky carbonaceous residue.

A Product of the Condensation of Oxalic Aldeh—Ugo Schiff.—The author has obtained the comp $C_{12}H_{14}O_3$, which he names hydro-hexa-glyoxal.

by Google

Action of the Amides upon Phenols.—Dr. Icilio Guareschi.—A continuation of the author's former papers upon the subject.

Action of Sulphur upon Carbonate of Lime.—Prof. A. Cossa.—The author has repeated Pollacci's experiments on the formation of sulphate of lime by the action of flowers of sulphur upon carbonate of lime in presence of water and at common temperatures with a negative result.

Reduction of Chloride of Silver by mean of Hydrosulphite of Soda.—G. Scurati Manzoni.—If a solution of hydrosulphite of soda is boiled with recently precipitated chloride of silver, sulphurous acid is given off, and there remains metallic silver in a state of fine sub-division.

Expansion of Fused Sulphur.—G. Pisati.—This lengthy paper, more physical than chemical in its character, is not adapted for abstraction.

Reagents for Phenol.—G. Tasca-Lanza.—The author, criticising Pollacci's paper on this subject, shows that thymol, benzilated phenol, essence of aniseed, &c., give the same brown colouration with chromic mixture as does common phenol.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in means or apparatus for extracting chlorine from chloride of lime. James Haithwaite, Brookfield Place, Belfast, Ireland. July 4, 1873.—No. 2318. The object of the invention is to facilitate the extraction of chlorine from chloride of lime. For this purpose the chloride of lime is placed in an air-tight cistern or chamber partly filled with water, and provided with one or more hollow shafts formed with hollow arms and capable of revolving, by which the chloride of lime contained in the cistern is agitated, and by a current of air passing through the shafts and arms the chlorine is extracted from the chloride of lime and mixes with the water, and the liquor when settled is drawn off for bleaching purposes.

Improvements in the manufacture of ferro-manganese and other metallic alloys, and in apparatus for that purpose. Alexander Browne, of the firm of Browne and Company, patent agents, 5, Southampton Buildings, Holborn, Middlesex. (A communication from the Foundries and Forges Company, Terre Noire, La Voulte and Bèssege, France). July 5, 1873.—No. 2335. The features of novelty of this invention consist in the application of a revolving furnace heated by gas or other means to the manufacture of ferro-manganese and other metallic alloys, also the mode of lining the furnace with carbon, magnesia, &c., and the special arrangement thereof, which allows it to be removed from the fire while it is charged.

Improvements in the treatment of natural phosphates for the purpose of obtaining what are commonly called artificial manures or fertilisers, and in apparatus connected therewith. Joachim Buquin Howard Howarth, engineer, Salford, Lancaster. July 8, 1873.—No. 2364. This invention consists in obtaining soluble fertilisers from phosphates by treating them with the fumes of burning pyrites or other sulphurous ores.

Improvements in the manufacture or production of paraffin oil. Edward Meldrum, Dechmont, Linlithgow, N.B. July 12, 1873.—No. 2407. This invention relates to the production of paraffin oil from coal or shale, and consists in effecting the distillation of coal or shale in a cupola or furnace similar to a blast-furnace, so constructed and arranged that the non-condensible or permanent gases from such distillation may be introduced above the place at which the air is admitted, in order that any free oxygen may combine with such gas before coming in contact with the products of distillation, and thus prevent their oxidation and destruction.

Improvements in preserving wood. John Clayton Mewburn, patent agent and consulting engineer, Fleet Street, London. (A communication from Alexandre Hatzfeld, Nancy, France). July 12, 1873.—No. 2411. The wood is impregnated with an insoluble salt which hardens it. The process may be carried into effect by boiling the wood in an extract of gallo-tannic acid, or by injecting this acid into the wood, and by afterwards boiling the wood in a solution of sulphate of iron. For oak the gallo-tannic acid may be dispensed with.

Improvements in the manufacture of sugar. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Louis Joseph Frédéric Margueritte, Paris, France). July 12, 1873.—No. 2413. This invention relates, firstly, to the purification of second- and third-quality sugars by adding the same to a saturated syrup of the first product at 35° Baumé, the mixture being worked up in a mixer, whereby the molasses adhering to the surface of the sugar is separated therefrom, and then passed to a hydro-extractor, a very white and pure sugar being obtained. Secondly. To accelerating and increasing the crystallisation of sugar, and extracting sugar from molasses by the employment of salts of soda, ammonia, baryta, lime, ontian, magnesia, manganese, iron, zinc, and other salts, which, n added to a saturated sugar solution will promote the more or less crystallisation of the sugar contained.

rovements in absorbing dilute chlorine, and in apparatus for that e. Walter Weldon, Abbey Lodge, Merton, Surrey. July 16, 1873.—No. 2449. This invention relates to the absorption, by means of any suitable milk or solution of an oxide or of a salt, of the chlorine contained in a mixture of that gas with other gases. I employ for this purpose a series of two or more vessels, each filled with the milk or solution to only a portion of its depth. I provide each vessel of the series with an agitator, by means of which I keep the milk or solution in motion, and project a spray of it into the upper part of the vessel. Supposing a series of five vessels, and calling them A, B, C, D, and E, I arrange them at different levels in regular succession, and so connect them that I can at will run off the contents of D into E, those of C into D, those of B into C, and those of A into B, and so, moreover, that the current of gases containing the chlorine to be absorbed can pass continually through the whole series of vessels in the opposite direction, or that from E to A. In passing successively through E, D, C, B, and A, this current of gases, as it grows weaker in chlorine, comes into contact with milk or solution continually less and less saturated therewith. When the contents of the vessel E have absorbed sufficient chlorine, they are run off, those of D being then run into E, those of C into D, those of B into C, and those of A into B, and fresh milk or solution into A.

Improvements in the manufacture of artificial manure, and in apparatus employed therein. Edward Charles Hamilton, Colchester, Essex, and William Richard Preston, Harold Court, Romford, Essex. July 16, 1873.—No. 2450. According to this Provisional Specification, sewage is mixed with or filtered through waste wool, wool-dust, or shoddy, and the materials are brought to a pulverulent form.

The clarification and purification of sewage, and the discharges of polluted waters from paper-mills, printing-works, dye-works, and factories, by means of precipitation. Frederick Jacobsen, merchant, 1, India Buildings, Victoria Street, Edinburgh. July 16, 1873.—No. 2454. 1. Utilising as a precipitant the sludge or refuse obtained after the ley-water of paper-mills has undergone the soda-recovering process. 2. The re-use of the sludge obtained after such process for the precipitation of polluted waters. 3. For accelerating subsidence, the use, in combination with such sludge or refuse as respectively before-mentioned, of common salt, sulphate of zinc, chloride of iron perchloride of iron, either singly or jointly, in a solid or soluble state.

NOTES AND QUERIES.

Chicory and Coffee.—I should be glad if Mr. Allen would further explain his formula, given in the Chemical News, vol. xxix., p. 140, for calculating the quantities of these substances in a mixture of them from the density. What is 1020·6? and why is the product of that, *minus* the density found × 100, divided by 12?—A. B. C.

Action of Chloroform on Iodoform.—20 grms. of chloroform were mixed with 0·2 grm. of iodoform; as chloroform contains often free chlorine, the chloroform was tested with potassium iodide, and the result proved the chloroform quite pure. The bottle with $CHCl_3$ and CHI_3 was exposed to the action of sunlight for about half an hour, after which the chloroform received a red tint, proving that free iodine was in solution. This solution was placed in an evaporating-dish, and, on evaporating the solution, a grey substance was received, giving with starch a blue, and with carbonic disulphide (CS_2) a red, tint. During the action of $CHCl_3$ on CHI_3, a gas was evolved, which, on being analysed, the presence of methyl hydride (CH_4) was apparent. The results from these experiments are that iodoform by the action of chloroform gives free iodine and methyl hydride.—Sergius Kern, St. Petersburg.

The Aqueous Solution of Phosphorus.—Four months ago, 25 grms. of phosphorus were placed in a black flask with 40 grms. of distilled water. With this water, the following experiments were made:—1. 10 grms. of this water were filtered and evaporated in a sand-bath: the residue were small pieces of phosphorus; immediately when dry they ignited. 2. A small quantity (5 grms.) of this water was evaporated till only half of the original quantity remained; some nitric acid was then poured, to change the P in solution into phosphoric acid, which was tested then with ammonium molybdate. A yellow tint and crystalline powder was received, showing that phosphoric acid was in solution. These experiments prove that phosphorus dissolves in water if a sufficient lapse of time be allowed.—Sergius Kern.

MEETINGS FOR THE WEEK.

Saturday, 9.—Physical Society, 3. Dr. Rae, "On Certain Physical Properties of Ice." Dr. Stone, "On the Fall in Pitch Occurring in a Strained Wire through which a Galvanic Current is Passing." Prof. Guthrie, "On an Absolute Galvanometer."
Monday, 11.—Society of Arts, 8. Cantor Lectures. Frederick Barff, M.A., "On Carbon and Certain Compounds of Carbon (Lecture V., Coal-Gas, its Composition and Purification, and Illuminating Properties."
— Royal Geographical, 8.30.
Tuesday, 12.—Civil Engineers, 8.
Photographic, 8.
— Anthropological Inst., 8.
Wednesday, 13.—Society of Arts, 8. Major-General Synge, "On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge."
— Geological, 8.

Errata.—Pp. 180, 181. Paragraphs (1), (2), (3), (7), *for* grains *read* grammes.

THE CHEMICAL NEWS.

Vol. XXIX. No. 755.

ANALYSES OF SCOTCH GOLD.

By A. H. CHURCH.

Through the kindness of Mr. Dudgeon, of Cargen, Dumfries, I secured for analysis some clean grain gold which had been lately washed from a burn at Wanlockhead. Mr. Dudgeon has collected a great deal of interesting information about the auriferous districts of Scotland, and their produce of the precious metal. I do not, however, purpose discussing these points on the present occasion, but merely offer the results of my analysis of the particular specimen of Scotch gold to which reference has just been made.

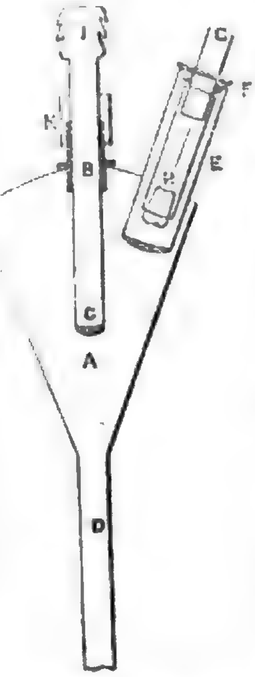
I also add an assay of another piece of Scotch gold (from Sutherlandshire). This specimen was secured for me by Dr. McNab, while the assay was very kindly made by Mr. G. H. Makins.

	In 100 parts.	
	Wanlockhead.	Sutherlandshire.
Gold	86·60	79·22
Silver	12·39	20·78
Iron	0·35	—
Sp. gr. at 16° C.	16·50	16·62

AN IMPROVED VACUUM FILTER-PUMP.

By W. JESSE LOVETT.

Those who have used the filter-pump described by Dr. Thorpe in his text-book of analysis know that the length of tube is objectionable in many cases, not only in use, but by reason of the room it takes in packing up. The form described below is intended to avoid this difficulty.



In the figure, A represents a cone turned up out of sheet metal, with a convex metallic cover. In the centre of this cover is soldered the outer ring of an ordinary screwed neck, such as is used in ordinary oil-can nozzles. To the inner ring of the neck is soldered a short brass tube, B, having a longer tube, I C, sliding tightly within it. The end, I, of this tube has a flexible pipe attached from the water supply, and the other end, C, has a piece o brass, drilled with a number of small holes, and fitted in to form a rose-jet. A tube, D, is fitted to the apex of the cone to carry away the water; and at one side of the cover is soldered a wide brass tube, E, having a screw-neck, F, holding a short narrow tube, G, on which is fitted one of Dr. Thorpe's admirably simple and efficient valves, H, consisting of a rubber tube with a slit in its side, and closed at one end. This allows air to enter the cone, but will not let any air leave it.

The screwed parts run down tight on leather washers to ensure their being air-tight, and the sliding part, B, is covered at K by a piece of rubber tube for the same purpose. If now the apparatus be connected to the main, and the water turned on, a constant rush of water is kept up through the rose, C, into the apex of the cone, A, and in so doing forces a quantity of air out of the cone down the tube, D. This exhausts the chamber, A, creates a difference of pressure at the valve, H, which opens and lets air in from outside; and if connected to a filter and flask, will cause a considerable suction beneath the filter, and so hasten the passage of liquid through. There was a good supply of water where the apparatus was tried, and the suction was so strong as to burst single papers, necessitating the tap being only partially turned on. The following are the results of two experiments tried, the first with a small filter, the second with a large one:—

	Expt. I.	Expt. II.
With pump	1 m. 34 s.	6 m. 50 s.
Without pump ..	4 m. 40 s.	35 m. 30 s.

The time is that taken to empty the filter in each case.

This apparatus may be made applicable to a water blowpipe by passing the tube, D, into a three bored rubber stopper fixed into a bottle, and provided with two other tubes, one to carry away the air to the blowpipe jet, the other to carry away the waste water through an adjustable orifice, as used in the blowpipe devised by Mr. Mills of Birmingham.

PRELIMINARY NOTE ON A NEW METHOD OF SEPARATING CALCIUM FROM MAGNESIUM.

By E. SONSTADT.

It is generally known, being, indeed, stated by Fresenius, that when, from a solution containing calcium and magnesium, calcium is precipitated as oxalate in the usual manner, a proportion of magnesium accompanies the calcium precipitate, howsoever large the proportion of ammoniacal salts present may be. It is not so well known that calcium is not completely precipitated under such circumstances, but that a certain proportion is held in solution by the influence of the magnesium salts. I have found that a solution of chloride of magnesium containing calcium, treated with oxalate and chloride of ammonium and ammonia, and filtered after two or three days, gives a solution which, evaporated to dryness and ignited for a long while, to drive off ammoniacal salts (much chloride of magnesium also volatilising), gives a residue from which water extracts, besides chloride of magnesium, some chloride of calcium. This is easily proved by adding pure oxalic acid in large excess to the solution of the residue, collecting after two or three days the precipitate that forms and heating it in a platinum crucible for an hour at a high temperature. The residue, digested in recently boiled water in a close vessel, gives a solution of hydrate of calcium the recognition of which presents no difficulty, since there is now a solution containing calcium with only a trace of magnesium to deal with.

Thus, in the ordinary method of separating calcium from magnesium, the result can only represent the truth by a fortuitous balancing of errors, the magnesium thrown down with the calcium being taken as compensation for the calcium retained in solution. Those more careful experimenters who re-precipitate their calcium two or three times, must necessarily get a result sensibly too low, and in *no* case is it possible to place any reliance upon the accuracy of the process.

Some years ago I suggested the use of tungstate of sodium for the separation of calcium from magnesium. When a perfectly neutral solution can be used, and when other alkaline salts are absent, or present in small proportion, tungstate of sodium throws down the calcium very completely, and perfectly free from magnesium. Yet, even when these exceptional conditions can be realised, it remains practically impossible to estimate the magnesium, since, when the filtrate, even after separating the tungsten as far as possible, is treated with an alkali phosphate and ammonia, tungsten may always be detected in the precipitate. This process, therefore, can never be of general utility, although I have found it very convenient in special cases.

In the course of recent experiments on the iodates, I have found that iodate of calcium is not sensibly soluble in a saturated solution of iodate of potassium, whereas iodate of magnesium is not precipitated from solution in any degree by iodate of potassium. If to 10 or 12 c.c. of a saturated solution of iodate of potassium a few drops are added of solution of sulphate of calcium, and after two hours the liquid is filtered, and oxalate of ammonium added to the filtrate, a slight opalescence appears after a while, due to the presence of a trace of calcium. But if the iodate of potassium solution to which the calcium salt was added is allowed to stand twenty hours, and is then filtered, and oxalate of ammonium added to the filtrate, not the slightest opalescence appears even after many hours. A slight crystallisation takes place, owing to a diminution of the solubility of the iodate of potassium by the presence of oxalate of ammonium, but the crystals entirely disappear, leaving the solution perfectly limpid, on addition of a very small proportion of water. The precipitation of calcium by saturation of the solution with iodate of potassium does not appear to be affected by the presence of alkali and magnesium salts, in whatever proportion these may be present. If, for instance, a small quantity, as a decigramme, of ordinary Epsom salts is dissolved in the least possible quantity of water, and four or five times its bulk of a saturated solution of iodate of potassium is added, after a few hours a crystalline precipitate forms, which may be collected on a filter, washed with solution of iodate of potassium, dissolved off the filter with dilute hydrochloric acid, and, minute as the quantity of calcium present is, it may be shown immediately by the precipitate falling on addition of ammonia and oxalate of ammonium to the strongly acid filtrate.

In separating calcium from magnesium, by precipitation of the former by iodate of potassium, it is obviously important, in view of the subsequent determination of the magnesium, to know if the presence of iodate of potassium hinders the precipitation of magnesium as magnesium-ammonium phosphate. So far from this being the case, I find that the double phosphate is even less soluble in a saturated solution of iodate of potassium containing some free ammonia than it is in a mixture of two parts ordinary "liquor ammoniæ" with one part of water. Thus, the addition of solution of iodate of potassium to the ordinary liquid containing phosphate of an alkali and much free ammonia, over precipitated magnesium-ammonium phosphate, renders the fluid at once opalescent, and occasions an additional precipitation of magnesium salt.

I may mention here, that I have never met with a specimen of any magnesia or magnesium salt in commerce, although sold as chemically pure, that did not contain a very sensible proportion of calcium. I believe the only available source of a magnesium salt that shall be free from calcium is distilled magnesium; in this, I have never found any trace of calcium.

ON SOME

RECENT PROCESSES FOR THE MANUFACTURE OF SODA.*

By C. W. VINCENT, F.C.S.

The object of this paper is the comparison of the principles involved, upon which Le Blanc's, our present, mode of soda-making is founded, with those of the more important processes designed to supplant it; and, in addition, to point out to chemists and inventors generally, by the example of this industry, that scientific correctness alone is insufficient to secure success.

The failure of only too many chemical processes arises from the want of technical skill on the part of their devisers, and also frequently from the abundance of technical skill bestowed on the operations they are desired to supersede. This is emphatically the case with those processes which have been designed with the view of replacing our present mode of soda-making.

There are some few remarkably brilliant exceptions, but as a rule the chemist misses his mark when he goes beyond the principles of a process, and endeavours to plan the apparatus and plant by which it is to be carried out on a large scale. Mechanical facts and economic facts are just as true as chemical facts; where the three fit together, the structure is firm and strong; if they do not fit—and, in the hands of unskilful builders, this is always the case—the result is merely a jumble of materials which the first shake reduces to ruins.

The labours of the technologist are apt to be overlooked, though not in this Society, which has ever done honour to those who successfully perform, as well as to those who successfully plan.

A scientific principle is of immense value. To use the language of Dr. Tyndall, "The man who has thoroughly mastered a scientific principle holds a key which opens many locks." And here we must distinguish between that which is a true scientific principle and that which is mere theory. A theory rests upon isolated and scattered facts; remove one, the theory falls to the ground. But a scientific principle is founded on a mass of facts tending to one common centre; the observer may stand with security on the summit of such a pyramid, and rejoice and profit by the more extended view he obtains. But who collects the facts? The experimenter. The mighty intellect grasps and arranges, but the skilful hands execute science. So also in the arts. Science, whether chemical or physical, while never losing sight of details, merely uses them as so many means to an end,—views them as the many leaves of a tree, important as a whole to its life and well-being, and distinctive of its species, but individually of little worth. Technology, on the other hand, spends its entire energies on perfecting details; not a leaf of the tree must be neglected, but each must be tended and cherished so that the tree may be the best of its kind.

The importance of a technical education is now being estimated at something more nearly approaching its true value, and much of this is undoubtedly due to the action of the Society of Arts, which, amidst the many outcries as to what should and what should not be the course pursued, has laid down a simple system that cannot fail to be successful, because it is true to the end to be accomplished. The examinations are threefold—1. In those branches of science, a knowledge of which is requisite as a foundation for technical instruction. 2. The technology of the manufacture in question, *i.e.*, the special application of the various branches of science to it. (We are too apt to call ourselves technical chemists, because we know the look of the apparatus used in a factory, and know the chemical theory of the process, but we ought also to know the physics of the process, and the mechanics of the plant). 3. Practical skill in the manufacture itself.

Technical education to be valuable must cover a wide range of subjects. No trade contains within itself the means of development and extension; as soon as a need is felt—and appreciation of the need is the mark of the inventor—he must seek outside the trade itself, in other arts and amongst other principles of science than those already involved, for the means of supplying that need. Those trades stand still which do not take advantage of such things in other trades which have a bearing on their own business.

The technologist should have a [illegible] knowledge of every practical art. This is of course impossible; but that which is possible, that which should be put within the reach of everyone, is a complete knowledge of the fundamental laws of mechanics, physics, and chemistry, as a foundation upon which to build all the special knowledge bearing upon the special pursuit to be pursued.

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* A Paper read before the Society of Arts, Chemical Section, April 10, 1874.

The prosperity of the iron trade is due to technology, as distinguished from chemistry.

The immense advances that have been made in smelting iron in the blast-furnace may be taken as entirely due to the improvements in the appliances used. Dr. Schweinfurth writes that savages in the heart of Africa make iron equal in quality to our best forged iron, the difference being that they make by pounds while we make by tons. But are our workmen much better instructed as to the principles of the process? It is only of late years that our iron-masters have penetrated into the arcana. The late researches of I. Lowthian Bell and C. R. A. Wright show how very far from accurate was the explanation of what took place within those igneous mountains.

The alkali trade owes its existence to the chemist, and its continued prosperity to his continuous oversight of the processes involved. The utilisation of the waste products—which began with the conversion of the hydrochloric acid into bleaching-powder, and has continued, step by step, until even the peroxide of iron in the burnt ore is rendered a valuable product—is entirely due to the close attention which has been paid by chemists to every reaction taking place amongst the constituents of the new material. Hence the great esteem, the high honour, bestowed on chemistry in the alkali trade. But this is only part of the truth as regards the success of this vast industry. Had not the chemistry been aided at each step of each process by technology, the vast progress made would have been impossible.

The chemical interchange which takes place when coal, lime, and sulphate of soda are roasted together, was recognised by Le Blanc, and worked out by him on what was considered a commercial basis; but so inefficiently were the mechanical and physical wants of the reaction supplied, that for a time the process was laid aside, its inventor subsisted on the charity of the English (to him a foreign) Government, and eventually died in a hospital.

Chemically, the process was entirely successful, the demand for soda was very great, and the price high; but the chemist was then unaided by the technologist.

Little more than half a century ago, the manufacture of soap and glass, the fictile arts, as well as those of bleaching and dyeing, the production of paper, were dependent upon the soda derived from soda-yielding plants, such as barilla and kelp, for their successful prosecution.

The kelp from Scotland alone was estimated at more than 15,000 tons annually; and, even as late as 1834, barilla to the amount of 12,000 tons was imported annually from Spain.

The price of kelp containing an average of 3 per cent of alkali was, at the close of the last century, £11 per ton. This price would render a ton of soda-ash worth £180—evidently a very large premium for the introduction of a new process.

The present price of soda averages £8 per ton, and economy in manufacture has been so studied in every branch of the process, that the premium for a new method is so small as to constitute one of the greatest difficulties that those reactions proposed to supplant our present mode of soda-making have to contend with.

The only method employed, as late as a hundred years ago, in bleaching the British-made linens and calicoes, &c., after boiling them in leys from kelp, was to saturate them with sour milk, and expose them for long periods to the action of the air; but, on account of the uncertainty of the climate, it was necessary that the best cloths should be sent to Holland, and, after a summer's absence, they were returned for use in England.

Writing-paper was made from the whitest rags, and the cost of the alkalies was as great as that of bleaching.

Both at home and abroad, the demand was so great that there was an absolute necessity of obtaining artificial soda. France being then at war with almost every other Continental nation, all her external supplies of potash, soda, and nitre were cut off. Under these circumstances, in 1792, an inquiry was instituted by the Government as to the best method of manufacturing soda from common salt.

The idea was not a new one. Nearly all great discoveries have to be shared amongst many investigations; the greatest honour being given to that man who, from the first crude imaginings and imperfect workings, elaborates a really practical plan.

From a very early period it was found that common salt, sodium chloride, $NaCl$, was too stable a compound to be directly attacked by carbonic acid. Sodium chloride was, however, easily converted into sodium sulphate by sulphuric acid; and the sulphate, being a more managable body, was, so early as 1777, looked upon as a possible source of soda carbonate by Malherbe.

In 1781, Mr. Brian Higgins decomposed common salt with oil of vitriol, roasted the dry sulphate with one-eighth of its weight of coal in a reverberatory-furnace, until the sulphate was reduced to sodium sulphide. Iron, lead, or other metallic oxides were then introduced, and caustic soda was obtained. It may here be remarked that patents for this process have been repeatedly taken out within the last few years.

The employment of metals or metallic oxides presented so many difficulties that no great commercial success was possible. It was at this crisis that Le Blanc, by substituting lime calcic oxide for the other metallic oxides, converted Malherbe's and Higgins's process, from what was little more than a chemical curiosity, into what has since become a great industry.

It was about this time that vitriol began to be manufactured on a large scale. Sulphuric acid had hitherto been made by distillation from copperas, iron sulphate. Chemistry devised a reaction by which sulphurous acid from burning sulphur should be oxidised to sulphuric acid by nitrous fumes.

Mixed sulphur and nitrate of potash suspended on an iron tray, in large wide-mouthed glass globes, partly filled with water, were set fire to by a red-hot iron, and the mouth was then closed. As soon as the charge was burnt out, another took its place, till the acid was found to be sufficiently strong, when it was removed into a glass retort, and concentrated much in the same manner as at present. This acid was sold for 2s. per pound, and was in much demand, on account of its purity, for several years.

This is all that chemistry has done for vitriol-making, with the exception of substituting pyrites for sulphur.

The technologist has to be credited with the next steps, which were the substitution of leaden chambers for the glass globes, burning the sulphur and the nitrate of potash outside the chambers, and sending in steam, instead of depending on the layer of water.

These changes apparently involve little genius or inventive skill, but without them the present eminence of vitriol-making, and through it of the alkali trade, as a commercial industry, could never have been attained.

(To be continued).

Analysis of Superphosphate, &c.—We are desired to state that at a recent meeting of the Chemical Section of the Philosophical Society of Glasgow, the following resolution was unanimously adopted (it was suggested by the paper read by the President of the Section, Mr. E. C. C. Stanford, which appeared in the Chemical News, vol. xxix., p. 190):—"That the Chemical Section of the Philosophical Society of Glasgow request the Committee of Section B of the British Association, at their next meeting, to appoint a sub-committee to inquire into the processes employed in the commercial analysis of superphosphates and salts of potash and soda and the statement of results."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 7th, 1874.

Dr. Odling, F.R.S., President, in the Chair.

TER the minutes of the previous meeting had been read d confirmed, Messrs. J. A. Fleming, Robert Routledge, d W. Kellner, were formally admitted Fellows of the ociety.

The list of donations was then announced, and the following names read for the first time:—Messrs. Henry Bird, John Taylor Leighton, William M. Habinshaw, Percy Tarbutt, Robert Yates, Toraske H. Tono, and Stephen Cooke.

The gentlemen elected Fellows of the Society after their names had been duly read the third time, were—Messrs. John McLachlan Glassford, George Jarmain, Arthur Brotherton Allen, and Maurice Lichtenstein.

The first paper, "*The Action of Ammonia on Phenyl and Cresyl Chloracetamide*," was read in French by the author, Dr. D. Tommasi. When phenyl chloracetamide is gently heated with a solution of ammonia in dilute alcohol, ammonium chloride is formed, which partly crystallises out. On removing this, and pouring the filtrate into cold water, a viscous product separates, somewhat resembling colophony in appearance, and having the formula—

$$\left.\begin{array}{c} C_6H_5 \\ H \\ CH_2.OH.CO \end{array}\right\} N.H_2O$$

he chlorine in the phenyl chloracetamide—

$$\left.\begin{array}{c} C_6H_5 \\ H \\ CH_2.Cl.CO \end{array}\right\} N$$

having been replaced by hydroxyl. It is therefore isomeric with phenyl glycocol. *Phenyl-hydroxyl-acetamide* is insoluble in cold water, and partly decomposed by boiling water into aniline and a new product. Alkaline solutions produce a somewhat similar decomposition. Phenyl-hydroxyl-acetamide is insoluble in hydrochloric and sulphuric acids, but soluble in glacial acetic acid. Heated with nitric acid, it dissolves, with evolution of nitrous fumes, and the addition of water to the solution produces a pale yellow precipitate. Cresyl-hydroxyl-acetamide—

$$\left.\begin{array}{c} C_7H_7 \\ H \\ CH_2.OH.CO \end{array}\right\} N,H_2O+\tfrac{1}{2}aq$$

is obtained by a process similar to the phenyl compound, which it closely resembles in its properties and reactions. An attempt to prepare the corresponding naphthyl compound was unsuccessful.

The President, in thanking Dr. Tommasi in the name of the Society, remarked that an aqueous solution of ammonia usually acted on these chlorine compounds in the same way as the dry gas, replacing the chlorine by NH_2, but the action here appeared to be entirely different, and more like that with potassic or sodic hydrate, introducing hydroxyl in the place of the chlorine.

Dr. Gladstone then read a paper, entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies (Part VII., On the Chlorides of Ethylene and Ethylidene)*," by J. H. Gladstone, F.R.S., and A. Tribe, F.C.S. The ethylidene chloride employed boiled at 61°, and its density at 13° was 1·201; the ethylene compound had a density of 1·272 at 14°; and the refraction equivalent of the two compounds was almost identical—namely, 34·6 and 34·5. The dry couple has but little action on either chloride; in the presence of alcohol, however, the ethylidene compound was attacked near its boiling-point, a gas being evolved, which consisted of ethyl hydride accompanied by a little ethylene, and a viscid compound formed which is zinc chlorethylate—

$$\left.\begin{array}{c} C_2H_5O \\ Cl \end{array}\right\} Zn$$

The behaviour of ethylene chloride was very different, but little gas being given off, and no zinc chlorethylate formed.

The President said they were glad to receive this new contribution on the action of the copper-zinc couple, showing, as it did, such a well-defined distinction between these isomeric chlorides, although it did not seem to afford an interpretation of the difference in their constitution—that is, that in one case H_2 in one of the methyl residues is replaced by two of chlorine—

$$\begin{array}{c} CHCl_2 \\ CH_3 \end{array}$$

whilst in the other one hydrogen in each is replaced by chlorine—

$$\begin{array}{c} CH_2Cl \\ CH_2Cl \end{array}$$

Dr. Gladstone replied that as ethyl iodide gave the compound—

$$\left.\begin{array}{c} C_2H_5O \\ I \end{array}\right\} Zn$$

so the ethylidene compound, the chlorinated ethyl chloride, gave—

$$\left.\begin{array}{c} C_2H_5O \\ Cl \end{array}\right\} Zn$$

whilst the ethylene dichloride, when treated with zinc, split up into ethylene and chlorine.

Mr. Charles E. Groves read a "*Note on the Preparation of Ethyl Chloride and its Homologues.*" The author, after having noticed the defects of the principal methods given in the chemical manuals for the preparation of ethyl chloride, gave an account of the various processes he had tried for preparing the ether in quantity. Passing hydrochloric acid into boiling alcohol, or into boiling alcoholic solutions of calcium chloride, sulphuric acid, and ferric chloride, all yield ethyl chloride, but accompanied by considerable quantities of hydrochloric acid. If, however, a solution of zinc chloride in about twice its weight of alcohol be treated in the same way, in an apparatus where the alcohol vapour is condensed and flows back again into the flask, the hydrochloric acid is completely absorbed by the boiling liquid, while pure ethyl chloride issues at the other extremity of the apparatus. This continues until the whole of the alcohol has been converted into the ether. Wood-spirit and amyl alcohol, when treated in a similar manner, furnish pure methyl and amyl chlorides. Phenol and cresol are unacted on. [The apparatus employed for the preparation of ethyl chloride by this method was exhibited in action.]

The President thanked the author for having communicated to the Society this elegant method of preparing ethyl chloride, and said that he should be inclined to attribute the peculiar action to the zinc chloride rather than the hydrochloric acid,—the zinc chloride acting on the alcohol, and producing ethyl chloride, water, and zinc oxide, the latter of which was again converted into zinc chloride by the hydrochloric acid—

$$ZnCl_2+2C_2H_5.HO=2C_2H_5Cl+OH_2+OZn.$$

Mr. Groves replied that a clear solution of zinc chloride in alcohol of the strength employed in the preparation of ethyl chloride gave off none of the haloid ether whatever when heated alone.

The last paper, a "*Note on a New Mineral from New Caledonia*," by A. Liversidge, was read by the Secretary. The mineral is found in veins traversing serpentine, and associated with chrome iron ore, steatite, and other minerals commonly occurring in serpentine. It is of a beautiful apple-green colour, and, on immersion in water, flies to pieces with a crackling sound, at the same time becoming translucent. Its hardness is 2·5, and its specific gravity 2·27. It is a hydrated silicate of nickel and magnesia, to which the author assigns the formula—

$$(NiOMgO)_{10}(SiO_2)_8+3H_2O.$$

The most nearly allied minerals are alipite and pimelite.

The Chairman having thanked the author for his communication,

Dr. Muller remarked that the mineral described appeared to be closely related to the "emerald nickel" found in the deposits of chrome iron ore of Texas, in North America, as to its mode of occurrence, &c.: the one, however, being a silicate, whilst the other, the emerald nickel, was a carbonate. He thought considerable caution should be used in assigning formulæ to such substances, as he believed the composition of samples taken from different parts even of the same deposit would be found to vary.

The meeting was finally adjourned until Thursday, May 21, when there will be a lecture on "The Sewage Question from a Chemical Point of View," by Dr. W. H. Corfield.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 7th, 1874.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. J. Sidebotham and Mr. J. A. Bennion were appointed Auditors of the Treasurer's Accounts.

The Chairman exhibited to the meeting some portion of the cast-iron roof from the Salford Station of the Lancashire and Yorkshire Railway, which, after having been up for a period of four years, was so much corroded and damaged that it had to be taken down. He attributed the effects to sulphuric acid and soot, arising from the combustion of the coal used in the locomotives passing under it, aided by the action of steam and vibration. He referred to a paper by himself communicated to the Society, and published in vol. ii. (2nd series) of its Memoirs, "On the Effects of Old Coal-Pit Water on Cast-Iron," where similar results had been produced by sulphuric acid, carbonaceous matter, and water; also to a case alluded to by one of the most distinguished members of the Society, the late Dr. W. Henry, F.R.S., of the rotting of cast-iron by the escape of steam from the junction of a pipe embedded in charcoal. Of course the rate of decomposition much depended on the quality of the iron; but as that metal was now so much employed in building and mining operations, he considered it desirable to bring before the public every instance that came to his knowledge where it had been damaged or decomposed.

"*On the Action of Nascent Hydrogen on Iron*," by William H. Johnson, B.Sc.

In a paper read before the Society last year, I showed that a piece of iron immersed in hydrochloric, sulphuric, or other acid which evolves hydrogen by its action on the metal, on breaking gives off bubbles of gas from the surface of the fracture. It subsequently occurred to me that these bubbles might be produced by subjecting the metal to the action of nascent hydrogen for some time, and without the aid of acid at all.

To test this, I connected two pieces of iron wire 0·07" diameter respectively with the copper and zinc plates of a battery of 50 Daniell's cells, and immersed them in a vessel of Manchester town's water at a distance of 1 inch aport. On closing the current, bubbles of hydrogen were given off from the wire connected with the zinc, but none from the wire connected with the copper, the oxygen liberated at the pole apparently forming oxide of iron which in twelve hours formed a thick smudge at the bottom of the vessel. After twenty-four hours the surface of the wire connected with the zinc was unchanged, but on moistening the fracture bubbles were given off abundantly, just as if it had been immersed in acid. The other wire, on the contrary, though much oxidised and eaten away, did not give off bubbles when broken.

A variety of experiments were made in the same way with pieces of wire varying from 3 to 20 inches long and immersed from five to twenty-four hours, ¼ inch to 4 inches apart, in pure Manchester town's water, all with similar results. With this exception, that when the wire connected with the zinc was of steel, no bubbles were visible to the naked eye, just like steel after immersion in acid Twenty-four hours in a warm room restored the iron to its original state, and no bubbles were seen on fracturing it.

The water in the last experiments was then replaced by an aqueous solution of caustic soda, when, after two hours, the moistened fracture of the wire connected with the zinc pole of the battery was found to bubble. Twenty-two hours' longer immersion, the battery working all the time, caused the bubbles to be more abundant; the toughness of the wire was also diminished, and its surface was blackened. The wire at the positive pole was, however, unchanged either on the surface or in toughness.

Three pieces of wire, each 12 inches long, were immersed in hydrochloric acid about 1·2 sp. gr., one being connected with the positive pole, the other with the negative pole of the battery, and the third unconnected with the battery. At the expiration of half an hour the two last pieces were found to bubble on being fractured, and were also more brittle. The one, however, connected with the positive pole was not in the least affected. Thus showing that simple immersion in acid is not sufficient to produce in iron the remarkable changes before described, unless it be accompanied by evolution of hydrogen.

In conclusion, if the oxidation of the surface of iron be, as a rule accompanied by the absorption of nascent hydrogen into the interior of the iron, then the diminution of strength and toughness consequent on this will affect iron ships, telegraph cables, and other structures in which iron is largely used and which are constantly immersed in water.

"*Does the Earth receive any Heat directly from the Sun?*" By Henry H. Howorth, Esq.

The term heat is one of unusual ambiguity. It has at least two meanings, which, if they do not exclude one another, are at least not commensurable. Their indefinite and careless use has created great confusion. The first meaning connotes the feeling heat, a purely subjective matter, whose investigation is a proper subject for metaphysical students, but with which we have nothing to do at present. The second meaning connotes objective heat, the force heat, that phenomenon of matter whose effects we can measure in certain definite ways. It is with this second meaning that we are concerned to-night. Having limited our subject somewhat, I wish to limit it further. The science of heat concerns itself with two main subjects, first, the transcendental problems which deal with the nature of heat, which endeavour to explain it as a form of motion, &c., &c. These conclusions may or may not be eventually confirmed by experience. At present they are powerful and ingenious theories which enables us to map out our knowledge, to arrange and classify it, but I humbly crave permission to doubt whether any of them may be considered a final solution, and *pro tanto* I must have my hands free. This is not really of consequence in our discussion to-night, for I have no intention of entering into such a difficult and crooked controversy. The nature of heat is, in fact, outside our present subject. Eschewing the transcendental problems, we shall very briefly consider only the direct effects of heat upon matter. So far, then, as our experience can take us, heat is a peculiar condition or phenomenon of matter, which we can modify, increase, or lessen, which is universally present in greater or lesser intensity, and which we measure relatively by a comparison with a certain fixed standard. However produced, whether by chemical action, by percussion, by friction, &c., &c., there is one result which seems universal, and which may be considered to be the correlative of heat.

This result is universally present, and modified in various ways it is probably the only result; so that, if we exclude the feeling of heat, we may define heat by using this result as an alternative term. The addition and abstraction of heat are correlative respectively with an increase and decrease in the bulk of the matter operated upon. If we add heat, we increase the bulk of the substance operated upon; if we abstract heat, we cause the portion of matter to contract and shrink, and the bulk is increased and diminished in certain definite proportions; and not only so, but the opposite holds good also, viz., that if we cause a portion of matter to shrink, we must in doing so abstract heat from it, while, if we increase its bulk in any way without adding more matter, we must, willingly or unwillingly, add a corresponding portion of heat. I believe this is accepted as an axiom in physics by the best judges, and accepted as universally true. Formerly some substances, such as bismuth, water between certain temperatures, &c., were quoted as exceptions to this rule, inasmuch as they expand in solidifying; but they are only apparent exceptions, for their aberrant behaviour has been shown, as I think beyond doubt, to be a phenomenon of crystallisation. Speaking of the most notorious case, that of water, Tyndall says:—"The arrangement of the atoms of water when solid require more room than they need in the neighbouring liquid state. No doubt this is due to crystalline arrangement. The attracting poles of the molecules are so situated that, when the crystallising comes into play, the molecules unite so as to leave larger interatomic spaces in the mass; we may suppose them to attach themselves by their corners, and in turning corner to corner to cause a recession of the atomic centres. At all events their centres retire from one another when solidification sets in. By cooling, then, this power of retreat, and of consequent enlargement of volume, is conferred."—(Tyndall's "Heat as a Mode of Motion," p. 107). These exceptions, then, I hold to be no exceptions at all. There is one substance, viz., india-rubber, whose behaviour is eccentric and not explainable in this way, nor at present, so far as I know, explainable at all; but with this solitary exception, whose *raison d'etre* I have no doubt will be shown to be as consistent with the general law as those of substances such as water, bismuth, &c., we may safely conclude, from our experience of matter, that it is a universal law that heat and expansion, cold and contraction, are correlative terms.

Having laid down an abstract axiom, let us now apply it to a concrete example, viz., the earth.

The old notions about the stability of the earth, when compared with the mobility of the sea, have been long since exploded. We now know that there is no such thing as absolute terra firma. We know that the earth in a less degree is mobile like the water, rising here and sinking there in apparently restless pulsations, waves, swellings, and subsidings. This being so, it becomes an interesting problem to determine whether these risings and sinkings compensate one another; that is, whether a rising in one neighbourhood corresponds to a sinking elsewhere, or whether the whole periphery of the earth is undergoing enlargement or diminution, is stretching or shrinking. To decide this by direct experiment is not easy, for since water is our gauge the same relative effect will be produced either by the sinking of an ocean-bed or the rising of an adjacent continent. But we have a considerable amount of evidence notwithstanding which points, so far as I know, in one direction and one only. There is first the *a priori* evidence.

There are two sciences which deal with the inner constitution of the earth: astronomy, which deals with it as a part of the great macrocosm, the universe; and geology, which deals with its inner life as a universe of its own. The question of the alteration in the earth's bulk has naturally been discussed by both astronomers and geologists, and discussed too from very different points of view, but both are agreed in one conclusion, viz., that the earth shrinking.

Since the days of La Place, the Nebular hypothesis has been generally received by astronomers as the one which best meets observed facts. This hypothesis predicates the existence of gravitation everywhere, and shows how, by its influence, the various heavenly bodies have become condensed from nebular matter. It predicates that this force is still active everywhere, and that everywhere within our observation we have a condensation of matter in progress, matter condensing from a highly-diffused condition to one of greater density. Thus each member of our system, it is argued, is gradually and surely nearing the sun, and at the same time is shrinking, and the various planets are, in fact, in so many stages of evolution, and exhibit for us the various phases which the earth has passed through and will pass through before it is landed in the sun. And the most ingenious and successful of our analytical astronomers and physicists combined, Sir William Thomson, has compared our universe to an elaborately constructed clock which is inevitably and surely running itself down, until it has exhausted its various forces and until each component member has fallen into the common centre. This is elementary enough. I only quote it to show that the evidence of astronomy is that the earth is contracting, and that its periphery is diminishing in area.

The conclusion of geology for our purpose is the same. It is argued by geologists that the earth was originally in an incandescent state, and that it has assumed its present shape after a gradual cooling, that is, a gradual contraction, which is still in progress. These are the words of Mr. Geikie, one of the most recent and competent authorities:—"Among the geologists of the present day there is a growing conviction that upheaval and subsidence are concomitant phenomena, and that, viewed broadly, they both arise from the effects of the secular cooling and consequent contraction of the mass of the earth." On both grounds, therefore, viz., those upon which astronomical and geological arguments are based, is it established that the earth is shrinking.

As the fire syringe discharges a certain amount of heat when sudden pressure is applied, which heat we can collect and measure, so we ought to be able to measure the amount of heat produced by the contracting of the earth's crust, although we cannot measure that contraction with a plummet. As we go down through the crust we ought to meet with evidence that the pressure of the strata has increased the temperature, and this we in fact do. In going down towards the centre of the earth we find an increase of temperature so wonderfully constant in all latitudes that we are constrained, if we accept the nebular hypothesis, to argue that this results, as it ought theoretically to result, from the pressure of the strata, *i.e.*, from the force of gravity. In some letters that I have recently written to *Nature*, I have tried to show how the areas of upheaval and subsidence on the earth are distributed, my conclusion being that the areas of depression are distributed about the equator, while the areas of upheaval have their foci at the Poles, that the earth is being strictured about the equator, and thrust out in the direction of its shortest axis; in other words, is shrinking in the region where the temperature is the highest, the tropics, and is stretching out in the regions of cold, or the Polar regions.

Now let us see how far we have travelled. We have postulated that all shrinking matter is giving out heat. We have shown that the *a priori* evidence is conclusive that the earth is a shrinking mass. We have also adduced evidence which shows that the earth is in fact hot where it should be hot, and cold where it should be cold, in accordance with the law of contraction; and it seems to me to follow necessarily that the earth is giving out heat, —is in fact a furnace, a heat-producing substance. This seems to be inevitable.

I need not stay to argue that both popularly, and also among scientific men, it is held as a cardinal doctrine that the earth receives a large quantity of its heat directly from the sun, and elaborate calculations have been made to show the terrific quantity of heat so received and the terrific energy which this represents. We are taught that, of the sun's heat which beats on the earth, one portion is reflected, another is absorbed, and that the latter is what we can alone recognise by our instruments, and whose energy is the subject of calculation. But the absorption of heat means, as we have argued, an increase of bulk, therefore whatever heat the earth absorbs must go to increase the earth's size. It is only on this condition that the earth can absorb heat at all, and it is only by the increase in bulk that we can, in fact, measure or gauge the heat.

But if the earth be shrinking, it is clear that it must give out more heat than it absorbs; it must, in fact, produce enough heat to neutralise the expansion caused by the sun, and some besides, the excess being measured by the amount of contraction that the earth is undergoing. But this means that any heat it receives from the sun is more than neutralised by its own heat; so that, if the sun gave us no heat at all, and the earth continued to contract as it does now, it would not be affected in temperature, save, perhaps, in becoming even hotter; for if we receive heat from the sun which, when absorbed, makes the earth expand, it is clear that a portion of the contracting force of the earth is spent and exhausted in neutralising this expansion, which would be set free in the form of heat if this had not to be neutralised. But I confess that, having brought the argument to this point, I am constrained to go a step further, and to say that if the earth be independent of the sun for its heat, that if independently of the sun altogether it is throwing out an amount of heat equivalent to the amount of its contraction, that it is unnecessary and unphilosophical to postulate the sun as a source of heat, and that we are bound, paradoxical as it may seem, to conclude that the earth does not receive any heat directly from the sun. This conclusion seems inevitable, and if it be, we must face the various difficulties that suggest themselves at every turn, and find a solution to them consistent with it.

I believe these difficulties are not hard to meet. It will be noticed that, in the question I propounded at the head of this paper, I use the word directly or immediately. When I say that the earth is itself the furnace which supplies the phenomena of heat which we study and feel, I do not mean that it does so entirely *per se*, and without any assistance from without. I predicate all through that such heat as the earth possesses is induced in it by the force which is contracting it, by the gravitating force, and this force, so far as our evidence goes, is derived nearly altogether from the sun. My argument is that the heat of the earth is mediately, but not immediately, due to the sun's influence, that the sun's influence causes the earth to contract, and that in contracting heat is squeezed out of it. That we derive no heat whatever *qua heat* from the sun; or, to use a simile, the voltaic battery supplies the electric current which induces the magnetism in the iron, but does not itself furnish the magnetism.

This at once removes a vast quantity of apparent difficulty, for wherever the sun beats there it exercises its influence of gravity, and the result is invariably an induction of heat, so that winter and summer, day and night, are dependent for their varying temperature on the sun, although in a different manner to that popularly supposed.

There is another and a more palpable difficulty that obtrudes itself at once upon one's notice in defending the position I am arguing for. It is said: surely, if we step out of the sunshine into the shade, or *vice versa*, and exclude the radiated heat from the ground, we shall find direct evidence, both from our feeling and from the usual effects of heat, that the sun's rays are distinctly hot, that in beating on our hand, on a moist surface, &c., &c., symptoms of absorption of heat at once present themselves—the hand grows hot, the moisture evaporates, &c. And this is true, in a larger way, of the superficial layer of the ground, which feels the intermittent effects of day and night, summer and winter, by absorbing more or less heat. How, then, do we account for this? for the heat must be absorbed from somewhere, and the only practicable source is the direct sunshine. My answer to this is very short. If we ascend through the atmosphere we rapidly find the temperature becomes lower; that, as we get nearer the verge of the atmosphere, and therefore nearer the point where there is no atmospheric absorption of the solar rays, we find the temperature to lower so rapidly, that we are justified in concluding that if we could get outside the atmosphere altogether we should find the scorching of the hand, the absorption of moisture, and the various effects we attribute to heat reduced to a minimum, and are justified in concluding that, if the envelope of the atmosphere were removed—if the earth were to be, such as the moon is, without an atmosphere—that its surface temperature would be but slightly affected by the direct sunshine. The effects of the sun's attraction would be distributed throughout the mass of the earth, causing a general contraction and a general relative temperature with its focus at the centre; but there would be no surface layer of an aberrant and peculiar temperature, and few or none of the effects we now find in the direct sunshine. I argue, and I think I am justified in arguing, that these peculiar effects are due entirely to our having an atmosphere, to the fact of there being a medium between the sun and ourselves. If this be so, it is clearly most consistent with our contention, for the sun's contracting force acts not only on the earth's solid matter, but on its gaseous envelope also, and in the latter case with much more powerful results. So that any surface exposed to the sunshine is exposed also to a column of air undergoing contraction or pressure on the part of the sun, and as this compressed air must give out its heat if it is in contact with any body at a less tension, it gives it out to my hand or to the moisture exposed to it, which in the one case feels hot, and in the other experiences an effect of heat, viz., evaporation. It is the column of air that is giving out heat, each ray that pierces it squeezes it and squeezes out of it a certain amount of heat which we attribute directly to the sun's influence, while in fact it is only mediately due to it. This, I think, satisfactorily explains the great and elementary difficulties of my position. I am not aware of any other difficulty which cannot be as easily met, and as I cannot see my way from escaping from the main conclusion at which I have arrived, I have ventured, paradox though it be, to present it for your criticism. To sum up this conclusion in a phrase, I hold that the earth receives no heat directly from the sun, the sun only supplying the contractile force which induces terrestrial heat.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—I think chemists owe their gratitude to Mr. Stanford for having called attention to some of the most important causes of discrepancy in the statements of the results of commercial analyses. Every analyst who has had experience in particular branches must deplore the want of greater unity among chemists, even in cases in which the truth is within their reach.

I was glad to see that Mr. Stanford mentions the case of the phosphates in the various sewage manures. He seems somewhat surprised that a certain well known agricultural chemist should not have replied to a challenge, three times given, to explain the grounds of an opinion which strikes everyone else as being untenable. Had Mr. Stanford known the chemist in question better, he would scarcely have expected a reply. The same gentleman recently read a paper on milk, which contained some absurd statements and glaring contradictions, some of which have since been pointed out in the journal in which the paper appeared.

But when the leaders of the profession make incautious statements, the misfortune is that their reputation causes the errors to be mistaken for the truth; and it is practically useless for less known chemists to dispute them, or to point out their inaccuracy, as the politic silence observed is taken by outsiders for "silent contempt," and people say "Professor So-and-so is a very eminent man, and is more likely to be right than Mr. ——."

Some time ago I examined an iron ore, the hydrochloric solution of which gave crystals of $PbCl_2$ when concentrated. Abundance of sulphur was also found, and on careful examination of the bulk fine veins of galena were distinctly visible. The results were reported accordingly, when it appeared that the sample had also been analysed by a London chemist with a large iron ore practice, who had not noticed the presence of lead, and had reported the entire absence of sulphur. A fresh sample was prepared by the importers of the ore. It gave me and a professional friend the same results as before, but the London analyst still denied the presence of more than a trace of sulphur, and though his attention was directed to the presence of lead he reported that there was none present. Fortunately, in this case, the truth came out, for one of the partners of the firm possessed sufficient analytical knowledge to enable him to readily recognise the presence of abundance of lead, though according to the *report* of the London analyst there was none. That he missed the sulphur was only natural, if he employed the method he has published for the use of others.

The same ore contained 0·1 per cent of P_2O_5, according to my own analysis. On acquainting this eminent chemist with the fact, he wrote saying that "0·10 per cent of phosphoric acid corresponded to only 0·028 per cent of phosphorus, an amount entirely unworthy of notice." As a matter of fact, 0·1 per cent P_2O_5 corresponds to 0·042 of P, not to 0·028 per cent as stated by the "chemist" in question. Even if the latter number were correct, as practically all the phosphorus goes into the pig, and the ore in question contained 50 per cent of iron at the outside, the iron made would contain 0·056 per cent of P, which, so far from being "entirely unworthy of notice," is nearly the maximum amount allowable in a Bessemer pig, for the manufacture of which the ore was intended.

The result of the discrepancy was not that the analyst in question lost a client, but that the importers concluded that, as sellers, it was better for them to employ a chemist who missed objectionable constituents, and would brazen out his errors, than to have analyses by a chemist whose certificates would have less weight with the buyers, and who called their attention to "profligate associates."

If space permitted I might tell how a certain chemist reported an ore containing much pyrites as "free from sulphuric acid," without mentioning other forms of sulphur, thus obliging his clients and satisfying such conscience as he possessed.

How another chemist reported stuff with 55 per cent of ash as "cannel coal of fair quality;" how a third gave evidence that he "could hold his hand for some minutes in the flame of CS_2 the temperature was so low," and how in subsequent cross examination he was made to admit that iron would melt in the flame.

There is but too much justice in the remark that "scientific men can be got to prove anything," and until chemists regard it as undignified to act as scientific advocates instead of merely giving their unbiassed opinions, there is not much hope of improvement.

But it seems a pity that chemists have not some means of expressing their opinion in cases of gross unprofessional conduct in a similar manner to the lawyers, for if so, there are one or two practitioners I could mention who would stand a fair chance of being "struck off the rolls," and one or two dozen who would never have been on.—I am, &c.,

Accuracy.

May 2, 1874.

ON THE INDIRECT DETERMINATION OF ALUMINIUM OXIDE IN THE PRESENCE OF FERRIC OXIDE.

To the Editor of the Chemical News.

Sir,—Your last issue contained a note on the above subject by Mr. R. W. Emerson MacIvor. The process he has sketched therein contains no new feature, and is well known. Allow me to direct his attention to a description of it in Church's "Laboratory Guide" (2nd edit., p. 142).—I am, &c.,

C. T. K.

May 9, 1874.

VALUATION OF SALT-CAKE.

To the Editor of the Chemical News.

Sir,—My former letter on this subject having called forth communications from two other correspondents, perhaps you will allow me the opportunity of replying.

Mr. Simmonds recommends a method of determining free HCl in salt-cake which is decidedly objectionable. Admitting the presence of a minute amount of that acid in a free state, the result of igniting the salt-cake, after addition of NH_4HO, will be the formation of NH_4Cl, which reacts on Na_2SO_4, forming NaCl and $(NH_4)_2SO_4$ (volatilised), the loss of weight being due therefore to H_2SO_4, and not to HCl.

With regard to Mr. Tinniswood's note, it is to be regretted that, at the great centre of our chemical manufactures a method of analysis so evidently imperfect should be adopted. The omission of $CaSO_4$ in the sum of the impurities cannot be defended on the plea of want of time, for an occasional determination might easily be made, and the average amount of impurities, excluding free acid and NaCl, would then be more correctly found to be 1·5 to 2 per cent, instead of 0·75.—I am, &c.,

Walter Tate.

Dublin, May 12, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 23, 1874.

Operation of Transfusion of Blood, Performed by M. Beheir at the Hotel Dieu.—M. Bouley.—M. Behier insists (among other things) on injection of natural blood without previous defibrination or diminution of temperature, and on performing the injection slowly, and in small quantities at a time.

Plane-Distribution of Pressures in the Interior of Isotropous Bodies in the State of Limited Equilibrium; Mode of Integration of Differential Equations.—M. Boussinesq.

Law of Astronomical Attraction, and the Mass of Various Bodies of the Solar System, and especially on the Mass and Duration of the Sun.—M. Vicaire.—The proportionality of attraction to mass is not a demonstrated truth, and, considered as an hypothesis, it is not verified by its consequences. It is far from being proved that what is called the *mass* of the sun really measures the quantity of matter it contains. There are reasons for thinking it is not so; and considering the enormous pressure at the centre, there is nothing unreasonable in supposing a mean density equal to ten or perhaps twenty times what is at present supposed (which will multiply the duration by so much). Considering the stellar period of the sun must have commenced at the end of the geological history of our globe, this should satisfy all the requirements of history and of geology.

Programme of a System of Geography Based on Exclusive Use of Decimal Measures, of an International Meridian 0°, and of Stereographic and Gnomonic Projections.—M. de Chancourtvis.

Note on Magnetism (continued).—M. Gaugain.—In part of this note the author studies some points connected with the constant magnetic state produced in a horseshoe magnet when the armature has been applied and detached so many times that more detaching does not further weaken the magnetism. It appears that the distribution of magnetism in a direction normal to the surface of the bar is very different in the case of *constant* remanent magnetism and that of remanent magnetism of the first kind. In the former case the density of the magnetism is nearly uniform, whereas in the latter it decreases rapidly out from the surface.

Refraction of Compressed Water.—M. Mascart.—The author followed M. Jamin's method, sending light through two tubes filled with water, and counting the interferential fringes which passed a point of the spectrum when a difference of pressure was produced. A change of pressure of 1 metre mercury caused the displacement of about seventy fringes, and as the tenth of a fringe could be measured, there was much precision in the arrangement. The number of fringes displaced by corresponding variations of pressure is not constant, but increases with the pressure. The author deduces from his experiments the coefficient of compressibility, and the liberation of heat produced by compression of water.

Reply to Critical Observations of M. St.-Claire Deville on a Method for Determination of the Densities of Vapours.—M. Crouillebois.

Atmospheric Dust.—M. Tissandier.—The quantity of solid matter contained in a cubic metre of Paris air (as measured by a method which the author describes) seems to vary between 6 and 23 milligrms. Thus a mass of air, 5 metres thick, over the Champ de Mars will contain 15 kilogrms. of corpuscles. Where they consisted of *débris* of wood, coal, or the like the length reach sometimes 1-10 m.m.; where of mineral matters, silicon, &c., the diameter varied from 1-100 to 1-1000 m.m. The average weight of sediment falling in twelve hours was 0·002 gr. The chemical composition of the dust was—Organic matters, burning brightly, 25 to 34 per cent; mineral matters, 75 to 66 per cent. Iron was found in notable quantity, and the author thinks part of it may come from planetary spaces. Lime, silicon, &c., were also recognised. M. Tissandier further analysed some dust, 1 m.m. thick, on one of the towers of Notre Dame not visited for many years. Its composition well represented that of the aërial corpuscles.

Two New Theorems on Surface of Waves.—M. Mannheim.

Greek Solar Dial found by M. O. Rayet at Heraclen in Latmos.—M. G. Rayet.

Magnetisation of Steel.—M. Bouty.—Hardly suitable for abstraction.

Calorific Effects of Magnetism in an Electro-Magnet with Several Poles.—M. Cazin.—The author enunciates the following simple law. When a straight iron core is magnetised by a series of similar bobbins traversed by a current in directions alternately opposite, and these bobbins determine equal concamerations, the quantities of heat produced in the core by disappearance of the magnetism are inversely proportional to the squares of the numbers of concamerations. The "differential thermo-magnetic apparatus" was a sort of differential air thermometer, the reservoirs of which were formed of iron cylinders (42 c.m. in length, 5 in. diameter, and about 2 m.m. thickness). The curved U-tube, containing water, showed the difference of pressure produced when one of the reservoirs became heated by magnetism. With a very delicate apparatus M. Cazin has been able to estimate in calories the thermal effect observed, and he hopes to succeed in determining the magnetic equivalent of heat.

Some Endosmotic Properties of the Membrane in the Egg-Shell of Birds.—M. Gayon.—This membrane, detached, permits molecular diffusion only in one direction. Endosmose is energetic from the outer to the inner surface, but almost *nil* the other way. The membrane, further, is readily traversed by the soluble azotised ferment, which has the property of inverting cane-sugar.

Differentiation of Movements in Plants, Provoked or Spontaneous; Study of the Action of some Agents considered Anæsthetic on the Functional Irritability of the Stems of Mahonias.

Thermic Study of the Phenomena of Solution; Reaction of Water with Nitric Acid.—M. Berthelot.—This paper is not adapted for abstraction.

Compounds of Hydrogen with the Alkaline Metals.—MM. L. Troost and P. Hautefeuille.—The authors obtained definite compounds of hydrogen with potassium, K_2H, and with sodium, Na_2H. The former contained 126 volumes of hydrogen, and the latter 237 to 1 of the respective alkaline metals. Lithium, heated to 500° in hydrogen gas under a pressure of 760 millimetres, absorbed 17 volumes of the gas. Thallium, under the same circumstances, absorbed only 3 volumes.

Certain Bronzes from China and Japan.—M. H. Morin.—The composition of these bronzes is shown in the following table:—

	I.	II.	III.	IV.	V.	VI.	VII.
Tin	4·36	2·64	3·27	3·32	5·52	7·27	6·02
Copper ..	82·72	82·90	81·30	83·09	72·09	72·32	71·46
Lead	9·90	10·46	11·05	11·50	20·31	14·59	16·34
Gold	—	traces	—	—	—	—	—
Iron	0·55	0·64	0·67	0·22	1·73	0·28	0·25
Nickel ..	—	traces	—	—	—	—	—
Zinc	1·86	2·74	3·27	0·50	0·67	6·00	5·94
Arsenic ..	traces	0·25	traces	0·25	traces	traces	traces
Sulphur ..	traces	—	—	traces	traces	—	—
	99·39	99·63	99·56	98·79	100·32	100·46	100·01

Researches on the Formation of Superphosphate of Lime.—M. J. Kolb.

Trichloracetates and their Derivatives.—M. A. Clermont.—The author has obtained trichloracetyl-urea—

$$C_6H_3Cl_3N_2O_4,$$

by causing anhydrous phosphoric acid to react upon the trichloracetate of urea.

Red Colouring Matter of the Blood.—M. Bechamp.—The author, by a long and somewhat tedious process, has isolated the red colouring matter of blood, in which it is easy to show the presence of iron.

Use of the Bisulphate of Potash for the Distinction of Natural Sulphides.—E. Jannettaz.—This salt may be employed in the state of crystals, or fused at a gentle heat, or in solution. In the two former states, it is ground in a mortar with the sulphides under examination. The following results were obtained:—

A (1). *Action of Crystalline Bisulphate of Potash with the Native Monosulphides.*—

Galena, PbS	Intense escape of sulphuretted hydrogen.
Alabandine, MnS	Energetic action.
Blende, ZnS	Weaker.
Greenockite, CdS	Perceptible.
Millerite, NiS	Weak in Bohemian specimens; no action in American.
Chalcosine, argyrose, cinnabar	Nothing.

The concrete blende of Raibel acted more energetically than that of Dauphiné.

(2). *Action of the same Salt on Sulphides of the Formula* $M_nS_{(n+1)}$.—

Pyrrhotine, Fe_7S_8	Action slight, but distinct.
Troilite, Fe_7S_8	As above.

In all these cases, acetate-of-lead paper held above the mortar turns brown more or less rapidly—immediately with galena and alabandine, and quickly even with blende and pyrrhotine. There was no disengagement of sulphuretted hydrogen with cubic pyrites, marcassite, chalcopyrite, smaltine, cobaltine, stibine, bismuthine, boulangerite, haidingerite, bournonite, jamesonite, zinkenite. Steinmannite and kobellite (of Hfvena, Sweden) give a strong escape.

B. *Action of the Bisulphate in Solution.*—It acts very energetically upon alabandine; distinctly, though less powerfully, upon galena; less easily upon blende, which requires to be pounded; and not at all upon the remaining native monosulphides. This reaction is valuable for detecting galena in certain compound minerals, for distinguishing alabandine (MnS) from hauerite (MnS_2). Pyrrhotine or magnetic pyrites may be thus detected in mixture with other sulphides.

Moniteur Scientifique, du Dr. Quesneville,
February, 1874.

Preparation of Oxalic Acid from Sawdust, Bran, and Lignose.—W. Thorn.—Oxalic acid is now prepared on the large scale by heating the lyes of potash and soda in certain proportions with sawdust. It has been fully proved that in this process potash cannot be entirely replaced by soda. By the reaction of soda alone upon wood very little oxalic acid is produced, sometimes mere traces. For preparing the mixtures a round iron tank is employed, 5 centimetres high, 10 centimetres in diameter at the bottom, and 13 centimetres at the top. The sawdust is introduced into the boiling lye at 30° to 40° B., and the whole is heated over a naked fire with continual stirring. If the lye is concentrated to 42° B., it is absorbed by the sawdust, and the laborious agitation of the mass is dispensed with. In the course of his experiments the author remarked that there are differences in the yield according to the thickness of the stratum of materials operated upon. In consequence a second series of experiments was carried out, in which the mixture was heated in flat shallow sheet-iron dishes, the depth of the layer being from 1 to 1·5 centimetre. The sawdust employed in the experiments was from pine-wood, and contained 15 per cent of moisture. The action of soda alone upon the sawdust was tried in the proportion of 2 to 4 parts of hydrate of soda to 1 of the wood. The results were—50 grms. sawdust heated with 100 parts of soda in an iron pan gave—At 200° C., 36 per cent of oxalic acid on the wood; at 240° C., 32·2 per cent of oxalic acid on the wood. If heated in thin layers—At 200° C., 34·68 per cent; at 240° C., 31·60 per cent. With 25 parts of wood to 100 of soda—At 240° C., 42·3 per cent. If heated in thin layers—At 240° C., 52·14 per cent. When the heat is above 200° C., the process must be carefully watched, as in case of a sudden rise of temperature the oxalic acid already formed may suffer decomposition. A mixture of potash and soda, according to general experience, gives results equal, if not superior, to those furnished by potash alone. As regards the proportions authorities differ. Fleck states that in the establishment of Roberts, Dale, and Co., Warrington, 1½ parts of hydrate of potash are used to 1 part of hydrate of soda. According to another account 1 equivalent of potash is used to 2 equivalents of soda, which would approximately agree with 1 part of hydrate of potash to 1½ parts of hydrate of soda. In Kuhneheim's works at Berlin the two alkalies are used in equal equivalents. With a mixture of 20 parts potash and 80 parts soda, a peculiar and violent decomposition sets in on every trial, even at a temperature as low as 180° C. Heat was applied from forty-five minutes to an hour.

Ratio of Potash to Soda	Temperature. Degrees C.	Number of Experiments.	Percentage of Oxalic Acid on the Wood used.
20 : 80	190	2	19·78
"	200	1	21·50
"	240	2	30·04
30 : 70	190	3	21·38
"	240	4	38·89
40 : 60	190	1	14·00
"	200	3	30·35
"	240—245	4	43·70
50 : 50	200	2	25·76
"	240—245	4	39·04
60 : 40	200	3	30·57
"	240—245	4	42·67
80 : 20	200—220	4	45·59
"	240	3	61·32
90 : 10	240	[illegible]	64·24
100 : 0	240—245	3	65·51

In these experiments, therefore, potash alone proved superior to any mixture of the two alkalies. An essential difference is perceived when the mixture of wood and alkali is heated in thin strata. Sawdust was anew mixed with the boiling lye at 42° B. in the proportion of 50 grms. of the wood to 100 grms. of the alkali. All the lye was absorbed, and the mass was heated on iron plates in a layer of 1 centimetre in thickness. The mixture was frequently stirred, and the heating was continued from one hour to an hour and a half.

Ratio of Potash to Soda.	Temperature. Degrees C.	Number of Experiments.	Percentage of Oxalic Acid.
0 : 100	200—220	2	33·14
10 : 90	230	2	58·36
20 : 80	240—250	4	74·76
30 : 70	240—250	3	76·77
40 : 60	240—250	6	80·57
60 : 40	240—250	6	80·08
80 : 20	245	4	81·24
100 : 00	240—250	6	81·23

If the material is heated in thin layers, and if care be taken to avoid fusion the mixture 40 : 60, or 1 equivalent of potash to 2 of soda, is practically equal to potash alone. Experiments were next tried with currents of warm air directed over the heated mass. The production was not sensibly increased. The addition of manganese was not found useful. A series of special experiments proved that the yield from hard wood was smaller than that from soft species. A relative increase of the proportion of sawdust to the alkali was also tried, but the practical difficulties, both in heating the mass and in the subsequent extraction of the acid, appear serious. When the heating is completed, the mass is boiled with water till almost entirely dissolved, and the mixed decoctions are concentrated to 38° B., when oxalate of soda separates out in fine crystals. To free them from the mother-liquor filter-presses or centrifugals are used. If the fused mass has been properly boiled the mother-liquor may be obtained free from oxalic acid. To transform the oxalate of soda thus obtained into oxalate of lime, it is dissolved in boiling water, and milk of lime is gradually added, so that the lime may be in slight excess. The liquid must be rather dilute or the decomposition is tedious. If a filtered sample, acidified with acetic acid, still gives a precipitate with chloride of calcium a little more milk of lime is needful. When the decomposition is complete, the caustic lye is drawn off, the precipitate is repeatedly boiled with water, and filtered. For the decomposition of the oxalate of lime a large excess of sulphuric acid is required; 3 equivalents of acid to 1 of the oxalate. The oxalate of lime is made up into a very thin paste with water and the necessary quantity of sulphuric acid, let down to 15° to 20° B. is poured in with constant stirring. More water is added, and the whole is gently heated from one to two hours with continual agitation. When the decomposition is complete the liquid is filtered off, and the precipitate of sulphate of lime is washed, being frequently turned over. The filtrate contains oxalic and sulphuric acids, and sulphate of lime. It is concentrated to 15° B., when the sulphate of lime crystallises out. The clear liquid is then drawn off, and concentrated to 30° B. On cooling, the oxalic acid separates out in long crystals, which are further purified by re-crystallisation. The waste alkaline lyes are concentrated to 40° B., mixed with sawdust enough to absorb them, and calcined in thin layers on iron plates, or in a reverberatory furnace till a portion taken out and lixiviated with warm water shows but a very light colour. The dark grey calcined mass is lixiviated with the weak lye obtained when the oxalate of soda is decomposed with lime. The lixivium obtained is causticised with lime, evaporated down to 42° B., and is then ready for re-using.

Soft-Soaps and their Sophistications.—Dr. Vohl.—

Chemistry of Organised Bodies.—M. Ch. Blondeau. —This paper does not admit of useful abstraction.

Metallurgy of Bismuth.—M. Valenciennes.—A large supply of bismuth ore is now brought from Bolivia, where it is found in a vein near mines of silver and copper, at the town of Lucre (Lucra?). The ore consists of sulphuret of bismuth, mixed with iron and copper pyrites. The gangue is quartz. An average sample gave—

Bismuth	22·8
Iron	10·2
Copper	9·5
Sulphur	19·5

(The residue being probably silica.) Antimony, lead, and silver are found in small quantities. The ground ore is roasted for twenty-four hours at a dull red-heat in a reverberatory furnace with a flat sole. A little charcoal-powder is added from time to time, and the mass is frequently stirred with iron rabbles. The ore is next mixed with 3 per cent of charcoal, and a flux composed of lime, sulphate of soda, and fluor-spar. The mixture is heated in a reverberatory furnace with a sole hollowed out like a dish, so that the reduced metal and the slag may be drawn off at a vent-hole in the side of the furnace. At the beginning of the operation the damper is shut so that the reducing flame may facilitate the reaction of the charcoal on the oxide of bismuth, and prevent its volatilisation. The mass is often stirred up for two hours. The damper is then opened, and the fire urged to a white heat. At the end of two more hours the mixture is liquid, and is ready to be run. A mould of cast-iron, lined with clay, is placed under the vent-hole, and the plug is withdrawn. Three distinct layers are found in the mould, separated by their respective densities. At the bottom is a regulus of bismuth, then a matte of sulphides of bismuth and copper, and at the top a vitreous slag containing the iron. The crude bismuth contains 2 per cent of antimony and lead, the same quantity of copper, and traces of silver. The antimony may be removed by fusion with nitre, and the other metals are separated in the wet way.

New Method of Manufacturing Stearine.—Prof. Bock.—The author, or reporter, points out in this paper the errors of the prevailing methods, but the new method is not definitely and numerically described.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 3, March, 1874.

At the meeting of the Society, March 6, M. Clement Sans communicated an improvement on Grüne's encaustic for positives on paper. He takes—

Powdered gum arabic	2 parts.
Powdered sugar-candy.. ..	5 „
Transparent glycerine soap, well grated	10 „

Water enough to dissolve, and then adds—

White wax, shaved	10 „

The mixture is placed in an earthen coffee-pot able to contain five times the quantity, and boiled on the sand-bath with constant stirring. When cold it should have the consistence of good pomade.

Mdlle. Rosine Mezzara traced the yellow spots which spoil so many positives to the ash or the fumes of tobacco. MM. Lacan, Martin, and Peligot confirmed the view expressed in the above communication.

A new process for heliographic engraving is quoted from Figuier's "Année Scientifique." A photographic proof is applied to a sheet of zinc, when the silver, transferred from the paper to the plate, produces a metallic layer which enables the zinc to be attacked by very dilute acids.

M. Rodriguez, of Lisbon, forwarded to the Society a number of proofs in fatty inks obtained by his process.

M. Fleury-Hermagis exhibited very rapid objectives of flint glass, with a base of chemically pure minium. He also presented a large number of specimens illustrating a process which he has invented, and of which he communicated the details.

M. Geymet presented to the Society a volume printed and illustrated by his photo-lithographic process.

M. Pellet exhibited an apparatus for measuring fractions of a second of time, which may be used for determining the time required for exposure, and thus comparing the performance of two lenses. The description of the instrument is not sufficiently clear without the aid of an illustration.

The *Bulletin* contains a continuation of M. De Saint Florent's process of heliochromy, and of M. Th. Sutton's "Theoretical and Practical Studies."

Gazzetta Chimica Italiana, Anno iv., Fascicolo 3, 1874.

Identity of the Cymen of Camphor and the Essence of Turpentine.—E. Paterno.—The author has examined the cymeno-sulphates of lime, baryta, lead, copper, nickel, soda, and potash as obtained from camphor, and the corresponding salts as prepared from turpentine. He considers the identity of the two bodies indisputable.

Peroxide and Acid of Chromium.—Ugo Schiff.—This paper is not well adapted for abstraction.

NOTES AND QUERIES.

Filtering on a Large Scale.—Could you or any of your correspondents give me the best method of filtering silica (finely-divided) and alumina on a large scale?—E. T.

Hydro-Hexa-Glyoxal.—In Chemical News, vol. xxix., p. 207, you notice M. Schiff's hydro-hexa-glyoxal as $C_{12}H_{14}O_8$. I think it is a hexa-glycollic acid, and that the true synthesis would be—

$$5 \text{ glycollic acid} + \text{acid} - 10HO = C_{24}H_{12}O_{24},O + HO.$$

It corresponds with a similar condensation of salicylic acid.—S. E. P.

Coffee and Chicory.—(Reply to A. B. C.).—The formula in question was deduced from the mean densities of coffee and chicory infusions, which, according to the table given, are 1008·6 and 1020·6 respectively. If x be the weight of coffee, and y the weight of chicory, in 1 grm. of a mixture, then $x+y=1$, and $y=1-x$. The density of the solution will depend on the relative proportions of chicory and coffee present, and, if represented by D, then—

$$1008{\cdot}6x + 1020{\cdot}6y = D.$$

Substituting $1-x$ for y in this equation, we get—

$$1008{\cdot}6x + 1020{\cdot}6 - 1020{\cdot}6x = D$$
$$\therefore \quad 12x = 1020{\cdot}6 - D$$
$$\text{and} \quad x = \frac{1020{\cdot}6 - D}{12}$$

If x is the weight of coffee in 1 grm. of the mixture, then $100x(=C)$ is the percentage of coffee, and

$$C = \frac{(1020{\cdot}6 - D)100}{12}$$

The chicories I have tested have a higher infusion density than 1020·6, though the coffee infusions give results exactly agreeing with those of the chemists who compiled the table. Possibly the cultivation of chicory has improved, or the roasting is conducted in a different manner. I think the following formula would be preferable:—

$$C = \frac{(1023 - D)100}{14{\cdot}4}$$

I consider the estimation of chicory by the colour of the decoction gives the nearest approach to the truth.—Alfred H. Allen.

MEETINGS FOR THE WEEK.

Monday, 18.—London Institution, 4.
Tuesday, 19.—Civil Engineers, 8.
—— Zoological, 8.30.
—— Anthropological Inst., 8.
Wednesday, 20.—Society of Arts, 8.
Meteorological, 7.
—— Pharmaceutical, 11 a.m. Anniversary.
Thursday, 21.—Royal, 8.30.
—— Royal Society Club, 6.
—— Chemical, 8. W. H. Corfield, M.D., "The Sewage Question from a Chemical Point of View."
—— Zoological, 4.
Friday, 22.—Royal Institution, 8.
—— Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

W. H. Wilson.—Received.

P. H. Davies.—We are not aware that there is.

G. C.—Tollhausen's "Technological Dictionary" can be obtained at Asher's, Bedford Street, Covent Garden.

J. Hopkinson.—You had better advertise for what you require.

R. Irvine.—Only suitable for our advertisement columns.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 756.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.,
Public Analyst for the Borough of Sheffield; Lecturer on Chemistry at the Sheffield School of Medicine.

(Continued from p. 190.)

II. Tea (*continued*).

Foreign Leaves.—In the recognition of the presence of leaves other than those of the tea-plant, chemistry cannot be expected to play a very active part, though it may sometimes be made of service for obtaining an approximate estimation of the admixture. For this purpose, the percentage of ash, and the proportion the soluble bears to the total ash, are almost the only points on which there are at present sufficient data to be of use.

A specimen of *sloe-leaves* gathered early in September gave, after drying, the following results:—

	Per cent.	
Moisture	6·40	
Insoluble matter (on whole leaves)	55·90	
Tannin (by gelatin)	16·00	
Gum	8·90	
Ash soluble in water	4·70	8·74
Ash insoluble in water	4·04	

The above analysis shows a composition intermediate between black and green tea, except with respect to the ash, which is considerably higher than that present in tea.

Young sloe-leaves contain very little astringent matter.

For the detection of foreign leaves the botanical and microscopical characters are best fitted. Some of the sample to be examined is put into hot water, and when the leaves have unfolded they are spread out on a glass plate and held up to the light, when the venation, serration, &c., are readily observed. The primary venation of the tea-leaf forms a series of well-defined loops, which are not met with in most leaves used as adulterants. The serrations are not mere saw-teeth on the margin of the leaf, but actual hooks. The serration stops short somewhat abruptly at some distance from the base. The Assam tea-leaf is sometimes bi-serrate. At the apex of the tea-leaf there is a distinct notch, instead of a point.

If the under surface of the tea-leaf be examined under the microscope after the separation of the cuticle, the peculiar and characteristic space between the two cells of the stomata is readily perceived. The long unicellular hairs of the tea-leaf are also peculiar. The employment of caustic potash is desirable in observing these characters.

In the sloe-leaf the serratures are direct incisions, numerous, often irregular, and extending to the base. There are no spines. The hairs are shorter and coarser than those of the tea-leaf, and are marked in a peculiar manner.

The elder-leaf is more pointed than that of the tea plant, and the lobes are unequal at the base. The serratures are direct incisions. The midriff has hairs on it, and on the leaf itself there are several kinds of hairs, notably a short spinous striated hair which occurs on the upper surface.

The serratures of the willow-leaf much resemble those of tea, but the cell-walls of both the upper and under epidermis differ from those of the tea-leaf in not being sinuous, and there are long coarse striated hairs. When perfect, the elongated form of the willow-leaf sufficiently distinguishes it from tea, and the venation is also entirely different.

The chief foreign leaves added by the Chinese are those of *Chloranthus inconspicuus* and of *Camellia sasanqua*, the latter of which presents a close resemblance to the tea-plant.

III. *Adulterants Used for Imparting a Fictitious Strength.*

These are—Extraneous Tannin Matters, such as catechu; Lie-tea; Soluble Salts of Iron; and possibly Alkaline Carbonates.

Extraneous Tannin Matters, when used in excess, will be indicated by an abnormally high percentage of tannin. The lead process has a decided advantage in this respect, a sample of brown catechu apparently containing 119 per cent of tannin when examined by this method. This anomalous result is, of course, due to the different precipitating power possessed by the acids of catechu, but the consequence in practice would be that a tea containing a very small percentage of catechu in addition to its normal tannin would give a very high result with lead.

In the case of lie and caper teas the astringency is often very high, owing to an admixture of extraneous tannin matters.

Strong infusions of genuine teas, with the exception of some kinds from India, are quite clear, and do not become muddy on cooling. Tea adulterated with catechu gives an infusion which quickly becomes turbid on cooling.

Under the microscope catechu may often be recognised by its structure, and by the presence of acicular crystals.

I have made many attempts to discover a means of detecting catechu in tea by its chemical reactions, and may give the following tests, which are tolerably reliable, but should always be applied to the suspected tea side by side with a genuine specimen:—One gramme of the pure and the same quantity of the suspected tea are infused in 100 c.c. of water, strained away from the leaves, and precipitated while boiling with a slight excess of neutral lead acetate. The filtered solutions exhibit the following characteristic differences. About 20 c.c. of the solution of pure tea, when treated with a few drops of argentic nitrate (avoiding excess) and cautiously heated, gives but a very slight greyish cloudiness, or precipitate of reduced silver; but the same tea containing 2 per cent of catechu (purposely added) gives a copious brownish precipitate, the liquid acquiring a distinctly yellowish tinge.

When the proportion of catechu is somewhat larger, the filtrate from the lead precipitate gives a bright green colour on adding one drop of dilute ferric chloride, while the solution of pure tea gives only a slight reddish colour, due to the presence of acetate. On allowing this liquid to stand, the adulterated tea gives a precipitate of a greyish or olive green colour, the pure tea solution undergoing no change.

These tests, which depend on the properties of catechuic acid, and which answer with caper tea, together with the estimated proportion of astringent matters and the microscopic characters, render the detection of any considerable addition of catechu tolerably certain; but I doubt the possibility of detecting it when present in only small proportion.

Catechu is sometimes added to tea in a separate state, to impart additional "roughness," or to cover the presence of exhausted leaves, but the adulteration is usually made in the form of "lie tea" or of "caper."

Lie Tea consists of the dust of tea- or other leaves mixed with clay, sand, iron ore, &c., and made into irregular masses by means of gum or starch. It is said sometimes to contain even less desirable ingredients, such as "pig's dung," and though such statements must be taken *cum grano salis*, there are one or two facts within my own knowledge which certainly point in that direction. Probably the truth is that the "lie tea" is composed of the general sweepings of the manufactories, and, if so, its nature will vary according to circumstances.

Lie tea when put into hot water disintegrates and falls to powder, in consequence of the solution of the gum or starch used for procuring the adhesion of the other materials. The iodine-test for starch may be applied to the liquid after acidifying with sulphuric acid and decolorising with permanganate. The ash of lie tea is often as high as 30 or 40 per cent.

Caper Tea is the name given to tea which has been made up into little glossy masses by the aid of gum (or starch). That from the Canton district is invariably adulterated with sandy and magnetic matter, and often with extraneous astringents. It is often largely mixed with foreign leaves. I have never myself met with a caper tea free from one or more of the above adulterants, and I am in possession of a letter from one of the best-known tea-firms in England, stating that "there is not a specimen of genuine caper tea in the world."

The insoluble matter in caper and lie tea is very variable, but usually considerably less than is present in genuine tea. The gum in caper tea often amounts to 15 or 20 per cent. The soluble ash is often less than 2 per cent.

Soluble Iron Salts are sometimes added to tea to give an appearance of strength, by the formation of dark-coloured tannate of iron. They may be detected by shaking the powdered leaves with cold dilute acetic acid, decanting or filtering, and testing the liquid for iron by means of potassium ferrocyanide. By proceeding in this manner, there is no confusion between iron added as a soluble salt (probably as ferrous sulphate) and the ferric phosphate occurring as a natural constituent of the leaf.

Alkaline Carbonates may occasionally be added to tea, as they have the property of increasing the amount of colouring matter extracted on infusion, besides deepening the colour of the solution, even after the leaves are separated. It will be remembered that the addition of a small quantity of sodium carbonate during the re-drying of exhausted leaves prevented their detection by a professed tea-taster, who classed the tea containing 20 per cent of this adulterant as superior to the same tea in a genuine state but somewhat crushed. The presence of sodium carbonate will be at once detected by the persistent yellow flame produced when the soluble ash is heated on platinum wire. The presence of extraneous potassium carbonate would be detected by estimation of the alkalinity of the soluble ash. According to Zöller, the total amount of potash in the ash of genuine tea is 39·22 per cent, and that of soda 0·65 per cent. A number of genuine teas recently examined by Mr. G. W. Wigner showed, on titration of the aqueous solution of the ash with standard acid, an alkalinity (calculated as K_2O) varying from 1·36 to 1·88 per cent of the weight of the tea, the average potash of twenty samples being 1·62 per cent.[*]

All experiments on the ash of tea concur in showing that it is moderately constant in quantity and composition, not exhibiting the extreme variation noticed in the ash of beech-leaves.[†]

IV. *Facings and Colouring Materials.*

It is well known that till recently green tea was almost invariably "faced," the object being to impart a hue demanded by custom, but not naturally possessed by the tea-leaf.[‡]

Sometimes colouring matters have been used extensively for transforming black tea of low quality into superior green. Except in cases of this kind, where there is a direct fraud on the purchaser by giving the tea a fictitious appearance of value, it seems doubtful how far the facing of tea can be considered an adulteration, as it does not add appreciably to the weight of the article, and few will contend that the facing renders a tea injurious to health.

If a portion of the tea is observed under the microscope as an opaque object, the nature of the materials used in the facing may often be recognised at once. When a faced tea is treated with warm water, the colouring matters become detached, and the small portions rising to the surface may be floated on to a glass slide, and at once examined under a microscope, while the bulk of the facing is obtained as a sediment when the strained liquid is allowed to stand. This deposit often has a distinctly greenish colour, from the presence of prussian-blue or indigo. The latter of these is best recognised by the microscope; but the mineral pigment is detected by warming the tea with caustic alkali, filtering, strongly acidifying the filtrate with hydrochloric acid, filtering again if necessary, and testing the clear liquid for ferrocyanide with ferric chloride. On treating the sediment with the alkali it is sure to turn brown, but this must not be taken as a proof of the presence of prussian blue. The residue left after treatment with the caustic alkali should be treated with hydrochloric acid, and the insoluble portion washed, ignited, and fused with alkaline carbonate. In the product, silica is separated by solution in hydrochloric acid, evaporation to dryness, and re-solution in weak acid, the filtrate precipitated by ammonia and ammonium oxalate, and the liquid filtered from this precipitate tested for magnesium by sodium phosphate. Its detection here proves the presence of *steatite* or other *magnesian silicate*, the use of which gives the tea a peculiar smooth appearance and slippery feel.

Arsenite of copper, chrome yellow, and Dutch pink are also said to have been used as facings. Calcium sulphate is often employed.

Turmeric has been detected by some observers, but I have never met with it myself, the yellow colouring matter being generally of a ferruginous nature.

Caper tea is often glazed with graphite.

(To be continued).

ON THE
IMPROVEMENT OF THE SPECTROSCOPE.[*]

By THOMAS GRUBB, F.R.S.

The importance to which the spectroscope has within a few years reached as an instrument of research renders any improvement therein a matter of general scientific interest. Hitherto it has been under a disadvantage, which, though slight in amount, in those cases where the dispersive power of the instrument is moderate becomes a rather serious annoyance to the observer, when a number of prisms are used in serial combination, and the curvature of the spectral lines is proportionally increased, and only to be restrained *in appearance* by using a narrow breadth of the spectrum.

I have lately thought of a very simple and practical remedy (which may, indeed, have occurred to others, but which I have not seen mentioned), whereby those lines are rendered palpably straight in a very large field; but, previous to describing it, it is desirable to refer to a statement appearing in the *Astronomical Notices* for March, 1874, viz., that the spectral lines can be rendered perfectly straight, simply by returning them (after their first passage through a series of prisms arranged for minimum deviation) by a direct reflection from a plane mirror; and, further, that this has been accomplished in a spectroscope in construction for the Royal Observatory.

Such a statement has, as might be expected, produced several enquiries; in one case the querist is much interested, viz., by having a very large spectroscope in hands which, from its construction, involves the question of straight or curved lines resulting. It therefore seems desirable to remove any illusion which may be entertained, by a short consideration of the economy of the spectroscope, so far as the question of curvature is concerned.

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[*] Mr. Wigner has also estimated the total and soluble ash in a large number of teas, and his average results are in remarkably close accordance with those given on page 190. Thus the average total ash of twenty-four samples was 5·66 per cent, and the soluble ash 3·01 per cent. The lowest amount of soluble ash found by Mr. Wigner in a tea known to be genuine was 2·75 per cent, and the highest 3·35 per cent. —*Pharm. Journ.*, May 16, 1874.

[†] *Journ. Chem. Soc.*, 1874, p 490.

[‡] It is a fact well-known to the trade that a certain firm of tea-merchants use some method of removing the facing after the arrival of the coloured tea in this country.

[*] A Paper read before the Royal Society.

The curvature of the spectral lines may be considered as function of the dispersion of a prism; it (the curvature) not only always accompanies the dispersion, but further, its character is always the same with respect to the dispersion—that is to say, the centre of curvature will be found invariably to lie in the same direction with respect to the direction of the dispersion, the lines being invariably concave towards that end of the spectrum having the more refrangible rays.* This (which admits of the clearest proof) is adequate to show the impossibility that, by any kind of inversion, whether by reflections or otherwise, we can neutralise the curvature while doubling the dispersion.

If we examine the spectrum as produced by a series of prisms placed in the position of minimum deviation, we necessarily find that the lines of higher refrangibility, also their centres of curvature, lie towards the centre of the polygon, which the prisms themselves affect; and if we arrest the rays at any part of the circuit, and reflect them directly back by a plane mirror, this reflection reverses (right for left) not only the direction of the centre of curvature of the lines, but also the direction of the spectrum itself, both which are consequently doubled in amount after the rays have performed the second or return passage through the prisms; or (conversely) if, after the first passage through the prisms, we reflect the rays so as to pass through a similar set in such manner as to neutralise the curvature of the first set, we shall find the resulting dispersion reduced to zero.

The writer of the article having alluded to a difference between the reflection as given by a plane mirror and a prism of (double) total reflection, it may be observed that, so far as the dispersion and curvature are concerned, the cases are practically identical, the difference being that, in the double reflection, there is a *vertical* inversion of the spectrum, which, however, produces no discernible effect in either the spectrum or curvature of the lines; and as the spectroscope constructed with the double reflecting prism is known to produce, with double dispersion, double curvature, we here have an additional proof, if such were required, that the single reflecting mirrors does the same.

The remedy, or means of producing straight spectral lines, which I have alluded to is simply that of constructing the "slit" with curved edges instead of rectilinear. There is but little practical difficulty incurred in construction, and no apparent objection to its use. It may be objected that for such variation of prism power in use there should be a special slit. It is, however, only in spectroscopes arranged for high dispersion that the curvature becomes objectionable; in such there is seldom a change required, and a single slit of medium balancing power would probably remove all practical difficulty or objectionable curvature of the lines. I have found by trial that when two compound prisms were in use, giving a dispersion from A to H of nearly 14°, that the spectral lines were straight in a field of 1° when the radius of curvature of the slit was made 1·25 inches.

[Note on the above Paper.]

If a ray of light be represented in any manner through any number of prisms arranged as in a spectroscope, undergoing, it may be, any number of intermediate reflections at surfaces parallel to the common direction of the edges of the prisms, or more generally if a ray be thus represented or reflected at the surfaces of any number of media bounded by cylindrical surfaces in the most general sense (including, of course, plane as a particular case), the generating lines of which are parallel, and for brevity's sake will be supposed vertical, and if α be the altitude of the ray in sin α', α'', . . its altitudes in the media of which the refractive indices are μ', μ'', . . then—

(1). The successive altitudes will be determined by the equations—

$$\sin\alpha = \mu' \sin\alpha' = \mu'' \sin\alpha'' = \ . \ . \ .,$$

just as if the ray passed through a set of parallel plates.

(2). The course of the horizontal projection of the ray will be the same as would be that of an actual ray passing through a set of media of refractive indices—

$$\frac{\mu' \cos\alpha'}{\cos\alpha}, \ \frac{\mu'' \cos\alpha''}{\cos\alpha} \ . \ . \text{ instead of } \mu', \mu'' \ . \ . \ .$$

As $\alpha' < \alpha$, the fictitious index is greater than the actual, and therefore the deviation of the projection is increased by obliquity.

These two propositions, belonging to common optics, place the justice of Mr. Grubb's conclusions in a clear light.—G. G. Stokes, April 30.

ON BUTTERINE.

By J. CAMPBELL BROWN, D.Sc.

A chemist, seeing the word butterine, would be apt to suppose that it is a misprint for butyrin, but it is not so; it is the registered name under which a substitute for butter is introduced into this country from New York. This substance is prepared by the process referred to in Chemical News, vol. xxvi., p. 47; and described in Chemical News, vol. xxvi., p. 106, in *Pharmaceutical Journal*, October, 1872, and in Parkes's "Hygiene," 4th ed., p. 249. Its general appearance, taste, and consistence are very similar to those of ordinary butter; but, notwithstanding that its solidifying-point is lower than that of some butters, it retains much of the peculiar crumbly texture and fracture of dripping.

Examined according to the scheme given in Chemical News, vol. xxviii., p. 1, it gives the following results:— It softens at 78° F., and melts at 86°; when heated and slowly cooled, it obscures the thermometer at 62°, and solidifies at 60°. It contains—

Water	11·25 to 8·5
Salt	1·03 to 5·5
Curd	0·57 to 0·6
Fat	87·15 to 85·4
Colouring matter ..	— —
	100·00

The fat consists of olein, palmitin, margarin (?), a trace of stearin, and about 5 or 6 per cent of butter. When dissolved in about four times its weight of ether, and allowed to evaporate spontaneously, it does not deposit any fat until more than half of the ether has passed off, and, if the temperature is not below 60°, the deposit is not solid. The first deposit, when dried, fuses at 108°; the second deposit fuses at 88°, and solidifies at 64°.

Under the microscope, butterine does not appear to consist of acicular crystals of fat, but of irregular masses containing a few butter globules, particles of curd, and crystals of salt. With polarised light, the irregular crystalline structure is beautifully seen, and is clearly distinguishable from butter which has been melted and recongealed. When old and rancid, it acquires the odour and taste of dripping, but it keeps longer undecomposed than butter. When fresh, it is a wholesome substitute for real butter, and, if not brought into the market as butter, no one can reasonably take exception to its sale.

Butterine may be detected by the following characters:—

1. Its crumbly fracture.
2. Its loss of colour when kept melted for a short time at 212°.
3. The behaviour of its ethereal solution.
4. Its action on polarised light.

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* Professor Stokes has, indeed, investigated a form of compound prism, in which the resulting lines are straight, and in the same principle we may combine prisms (using, of course, media of different optical powers) in which, with *a balance* of dispersion remaining, the curvature might be found reversed; but this does not affect the general law. The curvature in that compound prism, which was the result of various trials, and first used in the spectroscope of the Great Melbourne Telescope, and now I apprehend in pretty general estimation and use, probably has a less proportional curvature of the lines than the simple prism.

THE VALUE OF MILK AS AN ARTICLE OF FOOD.

By JOHN HORSLEY, F.C.S.,
Analyst for the County and City of Gloucester.

Milk being one of the necessaries of life, its value in respect of the amount of butter and its other constituents becomes of great importance to society, more particularly as entire or pure milk is required for the support of children and invalids.

For a long time methods have been devised for estimating it—such as hydrometers, lactometers, &c.—which are all more or less worthless; and, indeed, the artfulness of some knowing persons has gone so far as even to adapt them to their own advantage, so that those who use them are deceived in their reliability, and the public in consequence have become powerless against such fraud.

Having given the subject many years' consideration, it appears that the only way of meeting it is by resting its value on the amount of cream, or rather butter, it yields when properly treated, discarding all other methods as absolutely fallacious.

There may be two classes of offenders concerned, viz., the milk-producer and the retailer. It has been satisfactorily proved, by me, that fresh milk will throw up the bulk (9-10ths) of its cream in from two to three hours, and very little afterwards; so that if cows be milked, say, at six in the morning, and the milk is not delivered before eight or nine to the retailer, a good part of the cream may have been skimmed off (for there are generally three trials), and even after that it is subjected to further treatment on the part of the retailer, that by the time it is vended little or no cream is left.

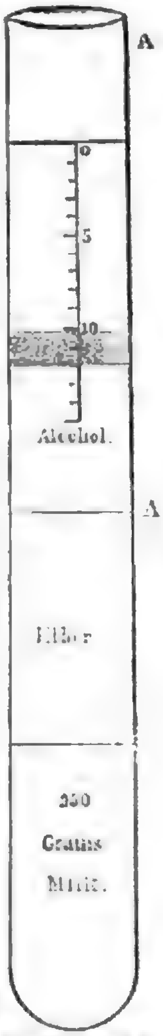
I may even go further, and state, as a matter of fact, that afternoon's milk is always the *richest*, and advantage is taken of it by some persons to skim off the cream, and mix the residuary liquor with next morning's milk. Besides serving a useful purpose in the animal economy, the retention of the cream helps *to preserve* the other constituents of the milk from undergoing fermentation, so that its abstraction is a *double* injury, not understood by those who commit it. Cream is worth 2s. 8d. per quart, but the skim only a 1d. or so; the milk trade is therefore evidently in a very unsatisfactory state, and, when water is added, it amounts to a kind of infamy which cannot be too much reprehended, and is deserving of the highest punishment and exposure.

The Method of Testing.—15 c.c., equal to a tablespoonful, or 250 grs., of milk, are first poured into the glass tube, A, which is 11 ins. long, and ¾ in. in diameter, and graduated up to 10 ins., each line from 0 to 20 being equal to so much per cent. A similar bulk, 4½ fluid drachms, of methylated ether is next poured in. The tube being taken in the hand, with the thumb *closely pressed* upon it, the contents are briskly agitated for not less than *four or five minutes*, by which operation the milk is broken up and deprived of its fat, or butter. A like measure of methylated spirits of wine is next added, and the whole well shaken up for at least five minutes more, when, on placing it in the stand, B, the oily, or fatty (buttery), matter will *rise to the surface* almost instantly, and can be easily read off, without any heat being used,—every line being equal to 4·15 grs. of solid butter, as proved by experiment.

1000 grs. of milk, yielding 10 per cent of cream, will therefore show eight lines of butter oil (1-5th less in bulk), equal to as follows:—

Two lines butter oil, from 250 grs.
of milk weigh .. .. 8·3 grs.
2
5) 16·6
3·32 per cent.

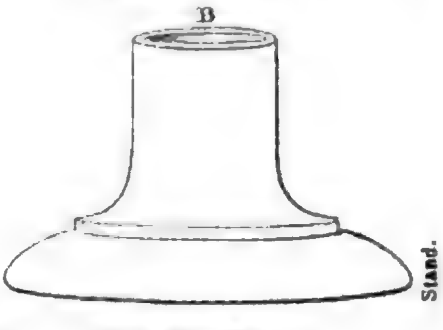
which is the natural quantity from milk of 10 per cent of cream, so that ten lines of cream would represent 33 grs. of butter. In this experiment the milk is separated into three parts, viz.—the butter which floats on the top, the clear liquor containing the milk salts, and the white flocculent matter (casein) which is precipitated.



Graduation of Butter Oil from a Table-spoonful of Milk.

If it be desired to analyse it further, the butter oil is to be carefully drawn up into a small Alsopp's minim glass syringe, and the *last* drop of aqueous fluid projected back again, leaving only the butter oil in the syringe, which, by depressing the piston, can be collected in a small weighed platinum or gold capsule, warmed over the water-bath for a minute or two, and the gross weight taken; the tare of the vessel being noted, the actual weight of the solid butter is easily ascertained.

In order to estimate the casein, sugar, and salts, proceed thus:—Fit into a funnel a piece of close cambric, and gently decant the clear liquor of the glass tube, A, add a little distilled water to the casein, agitate the tube well, and project the contents on to the filter, well cleaning it out afterwards with more distilled water, aided by a long feather. When all the liquid has passed through, put it by for evaporation to dryness, for estimation of the milk-sugar and phosphates, if necessary. Then, being provided with a few sheets of stout grey blotting-paper, take out the cambric filter, fold in two, and laying it between the blotting-paper, press out, by hand, all moisture. Re-open the cambric, and, placing it on a glass plate, scrape off the casein, dry it in a dish over a water-bath, and take its weight from time to time till it becomes constant.



Made of Box-Wood or Tin Loaded with Lead.

Having evaporated the clear liquor containing the sugar and salts to perfect dryness over the water-bath, the following would be the result of the analysis:—

Fresh milk density	1·030	
Cream..	10 per cent	
Butter or fat	3·32	Solid matter.
Casein or cheesy matter	4·12	
Sugar and salts	5·00	
	12·44 grs. per cent.	

plus 87·56 Inherent or natural water lost in the process.

Considering this as the *average* composition of genuine milk, any departure from or reduction of this amount of milk solids will indicate the *addition* of so much water, particularly if little or no butter exists, which is the *principal point* in question. Thus; supposing one-fourth or 25 per cent of water had been used, the amount of solids would be reduced 3·11 grs., making them 9·33, which, deducted from 100 of milk, would show 90·67 per cent of water, instead of 87·56 as before stated. On the other hand, if there be *more casein* than the natural quantity, and little or no butter, it would follow that skim had been used instead of water, which would be *equally an adulteration*, as decided by the Glasgow magistrates.

It would be as well to be provided with two of the graduated glass tubes with their stands, one to be used for estimating the amount of cream, by pouring in milk up to 0, and letting it stand for several hours, and another for treating 250 grs. or 4½ fluid drachms measure of milk with, first, methylated ether, and then alcohol as described, so as to estimate the lines of butter-oil from which its weight can be ascertained.

These two experiments (the cream and the butter) may, in most cases, suffice to show the actual value of the milk, the rest, or analytical part, may not be cared for by some persons.

But I would suggest, however, in justice to yourself as well as the milk dealer, the supply of milk should always be obtained *as soon as possible* after the known hours of delivery, if you want it genuine and unskimmed.

Methylated ether and methylated alcohol are cheaper than the purer kinds, and answer quite as well for milk experiments.

By way of recapitulation, if preferred, in the place of using the thumb to cover the mouth of the glass tube during the necessary agitation, a nicely fitting cork will answer as well, using equal quantities of milk and methylated ether first, then holding the tube in the right hand, with your watch in the other, *patiently* agitating it for full five minutes, afterwards pouring in the methylated alcohol up to only figure 10, so as to allow of sufficient room for motion, giving five minutes more for the rest or final operation of agitation, when the butter-oil will rise to the surface on a few minutes repose after placing in the stand.

Sometimes, according to the richness of the milk, as much as four or five lines of clear butter-oil may be obtained. The *whole success*, however (for there is no ambiguity or fallacy about it provided the milk is of good quality), depends on the *amount of agitation* used by the operator, which is analogous to that of churning.

If the film of butter-oil should grow thick from cold the application of the warm hand for a few minutes, or perhaps a piece of spongio-piline wrung out in hot water, to the upper part will render it perfectly bright for drawing off and estimating the actual weight of butter from the table-spoonful of milk used. Then, as two table-spoonfuls are equal to one ounce, multiplying that by twenty, we can tell how much butter a pint of milk will yield.

With regard to the detection of adulteration with water in cases where the evaporation of 250 grs. of milk to dryness, to ascertain the deficiency of solids from the *natural* quantity (12 grs. per cent) is inconvenient, recourse must be had to the use of a small glass spindle, graduated in fives down to 50, by which the density of the skim can be easily taken. Thus, say the cream, having been taken off by means of a separatory vessel, the residuary liquor will show the following variations in density:—

Sp. Gr. of New Milk at 60° F. compared with Water.	Sp. Gr. of Skimmed at 60° F.	Per cent Water used.
1·030 pure	1·031 pure	0
1·027	1·028	10
1·024	1·025	20
1·021	1·022	30
1·018	1·019	40
1·015	1·016	50

ANALYSES OF NATIVE SILVER.

By A. H. CHURCH.

Although innumerable analyses of native silver must have been made, very few have been published in English works of reference. Partly with a view of supplying this deficiency, and partly in order to throw light upon certain archæological questions connected with the arts of alloying and soldering silver, I have lately made several careful analyses of the native metal.

I here publish the results which I have arrived at in the case of two old specimens of so-called native silver from Allemont in Dauphiné. Both were purchased at Mr. Henland's sale in 1824, and were described as follows:—

"No. 256. Foliated Native Silver on Arseniate of Cobalt. Allemont, Dauphiné."

"No 324. Beautiful Specimen of Ramose Native Silver or Oxide of Cobalt. Allemont, Dauphiné."

The results of the analyses are placed under the headings of the above numbers.

	In 100 parts. No. 256.	No. 324.
Silver	71·69	73·39
Mercury	26·15	18·34
Antimony with trace of arsenic ..	(2·16)	(8·27)
Specific gravity at 16° C.	11·10	10·05

Both 256 and 324 were crystalline in structure, the latter particularly so: both were malleable and flexible. Several silver amalgams occur in nature, but they can scarcely be reckoned as constituting so many species. The first of the above given analyses corresponds pretty nearly to the formula Ag_5Hg, which demands 72·97 per cent of silver, and 27·03 per cent of mercury. The second analysis is not represented accurately by any simple expression, the formula Ag_9HgSb requiring—Ag, 75·11 per cent; Hg, 15·46 per cent, and Sb, 9·43 per cent. Thus it will be seen that the two specimens of so-called native silver of which I have given the analyses above, do not correspond with *arquerite* (containing 86·5 per cent of silver) nor with any of the poorer *amalgams* (those noticed in Dana's "Mineralogy," or Kerl's "Metallurgy") nor with *dysorasite*. But this latter mineral is recorded from Allemont, and so far as its percentage of silver is concerned, does not widely differ from our second mineral, though it is an antimonide of silver without mercury if the published analyses be conclusive.

ON SOME RECENT PROCESSES FOR THE MANUFACTURE OF SODA.*

By C. W. VINCENT, F.C.S.

(Continued from page 211).

As already stated, sulphate of soda is formed by the action of sulphuric acid upon common salt, but this does not express the whole reaction. The first product contains much acid sulphate, and part of the salt escapes being acted on. This was probably one of the great rebuffs Le Blanc had to encounter. The reaction is—

$$2NaCl + H_2SO_4 = NaCl + NaHSO_4 + HCl.$$

In order to completely convert the salt into neutral sulphate, it has to be heated strongly, when—

$$NaCl + NaHSO_4 = Na_2SO_4 + HCl.$$

And the second equivalent of hydrochloric acid is set at liberty.

The apparatus for making salt-cake has been very troublesome to adjust. At first a reverberatory furnace was used for the whole process. Then a division was made, each decomposition being made separately, that in the wet way in a lead-lined pan, the products being afterwards transferred to a brick bed for roasting. Lastly, a concave iron pan was substituted for the leaden one, with great diminution of expense, enabling stronger acid to be used, and preventing the formation of so much bisulphate of soda.

These furnaces are usually set in pairs. The flues pass over and under the salt-cake pans and beds, but not through them.

When a demand arose for bleaching-powder, the hydrochloric acid, which up to that time had been allowed to escape into the air, became valuable, and had to be condensed. The chemist supplied the means with which he was most conversant, a series of Woulfe's bottles on a large scale. A technologist, however, was at hand, one who was not only a thorough chemist in the fullest sense of the word, but also a mechanician and a physicist. I mean Mr. William Gossage, of Widnes, of whom it may most truly be said, as regards the alkali manufacture—

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* A Paper read before the Society of Arts, Chemical Section, April 30, 1874.

> "Nihil erat quod non tetigit; nihil quod tetigit non ornavit."

Mr. Gossage, with that keen insight which eminently characterises him, saw at once, that which it has taken many subsequent years to impress upon the scientific world at large, that the individual molecules of gases act independently of each other, and that if attacked in mass, only those on the outside are affected. He therefore conducted the hydrochloric acid from the salt cake pots to the base of towers filled with coke, from the top of which a stream of water was allowed to trickle slowly. The gas and water meeting, each in a fine state of division, complete condensation takes place, the independent molecules of water and of gas come into close contact, and in consequence, a stronger acid is obtained than would otherwise be possible on so large a scale of working.

If the towers are of sufficient height, two only are requisite to effect the complete condensation of the acid, but three or more are connected together if necessary.

Having obtained the sulphate of soda, technically known as salt cake, the next and most important process is entered upon—its conversion into carbonate. The sulphate is crushed into small fragments, mixed with its own weight of limestone or chalk, and half its weight in small coal. We have here—

$$\begin{array}{ccc}\text{Sulphate of Soda.} & \text{Chalk.} & \text{Coal.} \\ Na_2SO_4 & CaCO_3 & C\end{array}$$

which are fused together. This reaction has been variously represented by chemists. According to Dumas—

$$Na_2SO_4 + CaCO_3 = Na_2CO_3 + CaSO_4$$

The sulphate of lime in contact with incandescent carbon yields its oxygen, and carbonic oxide is evolved, leaving proto-sulphide of calcium in admixture with the carbonate of soda.

Other chemists look upon the reaction as proceeding by two successive stages—the reduction of sulphate of sodium by carbon to sulphide of sodium, which is afterwards carbonated at the expense of the limestone.

In my opinion Mr. Gossage's view, communicated to the British Association in 1861, is most in accordance with the facts, and certainly represents most accurately the resulting compound. His equation is—

$$2Na_4SO_4 + 3CaCO_3 + 9C = (2Na_2CO_3 + 2CaS + 1CaO) + 10CO \text{ evolved.}$$

The compound substance within the brackets is known as black-ash.

The furnace employed is of the ordinary reverberatory type. The charge is introduced at the end furthest from the fire; when hot throughout it is removed to the fluxing bed, a fresh charge being at the same time introduced. As soon as the mixture becomes soft, and forms clots, it is turned over with an iron oar, until the whole has the consistence of dough. Jets of inflamed sulphuretted hydrogen and carbonic oxide then begin to issue from the mass, a sign that the reaction is complete, upon which the charge is withdrawn from the furnace into iron barrows, each barrowful constituting a "black-ash ball."

Recent researches have abundantly confirmed the old maxim of black-ash men, that the more porous the black-ash, the more easy the extraction of the soda. It is therefore bad working to let the fluxing process go far enough to produce a close heavy black-ash. Black-ash, of course, contains many accidental impurities, but the greater part of the mass consists of carbonate of soda, sulphide of calcium, and lime.

Sulphide of calcium is insoluble in water; lixiviation is therefore easy, but to secure the whole of the alkali is by no means easy, and the services of the technologist have been exceedingly valuable to the soda maker in this stage of the process. It is essential to dissolve the whole of the alkali, and yet to use as little water as possible, in order to save fuel in after concentration of the liquor. This could not be done by one washing, however long the water remained in contact with the black-ash.

The apparatus at present in use consists of a series of vats with perforated false bottoms, upon which the roughly broken black-ash is laid; a pipe runs upwards from the the lower space of the vat which leads into the upper part of the next vat. This is in a like manner fitted with a communication between its false bottom and the upper part of the succeeding vat, and so on. When in regular use, the vats contain black-ash at various stages of lixiviation diffused in their corresponding liquors, one being filled with fresh black-ash, the furthest off in the series containing residuum, all but deprived of its soluble matter. A supply of warm water is run upon the nearly spent vat; this, after permeating the residuum, and becoming impregnated with alkali, rises through the pipe from the false bottom, and flows into the upper part of the second vat, through which it passes, takes up more alkali, and goes to the third, and so into the fourth, where it meets the fresh balls. When the black-ash in the first vat is exhausted, it is shut off from the series, emptied, filled with fresh balls, and becomes the fourth of the series.

The liquor from the black-ash vats is run into tanks and concentrated by the waste heat from the black-ash furnaces; the crystals as they are deposited are fished out, and roasted in a reverberatory furnace, termed the finishing furnace. The product of this furnace is commercial soda-ash, of 52 to 54 per cent. Soda crystals of commerce are formed by the solution and crystallisation of soda-ash. Bicarbonate of soda is made by treating the crystals with carbonic acid.

So well have technologists exercised their skill that for seventy years has Le Blanc's process been worked, and, though attacked on all hands, has nevertheless survived all its opponents, and appears likely to be able to fight its battle against any yet remaining in the field.

I use this phrase advisedly for it is a sober fact that, with the exception of a few processes dealing with materials too expensive for commercial use, none of the so-called new processes but are founded on old and well-known reactions.

Considering the threefold reaction involved in Le Blanc's process, the question, however, arose—Cannot the chlorine in salt be replaced by carbonic acid or oxygen in some more direct way?

The use of litharge and zinc oxide were proposed by Scheele. He found that by triturating either of these substances with salt and water, the salt was decomposed and caustic soda formed. This process fails chemically, so that we do not need to take technology to task for not having done more with it. From time to time modifications of the reaction have been devised, but always with the same result, viz., that 90 per cent of the soda in the common salt remains unconverted.

The mutual decomposition of carbonate of potash and common salt, was at one time made use of for the production of carbonate of soda and chloride of potassium. Here was an interchange of values, and when the potassic chloride fell in price, through abundant and cheaper sources of supply being discovered, the process came to a natural death.

There is one direct process which, however, technology may one day bring to the front, a reaction first discovered by Sheridan, and afterwards improved upon by Swinburne. When steam and common salt are brought together, at a very high temperature, the oxygen of the water combines with the sodium, producing caustic soda, and hydrochloric acid is set free. The process is long, and there is much difficulty experienced from the corrosive action of soda upon the retorts at the high temperature required. This difficulty was to some extent overcome by Powers and Dale, by mixing the salt with scrap iron and passing over it superheated steam whilst heated to redness; but better and more efficient apparatus is required before this process can compete commercially with Le Blanc's method.

Blanc, Bazille, and Tilghman have endeavoured to overcome the action of soda upon the apparatus by presenting to it at the moment of decomposition a body capable of combining with it. Blanc and Bazille use silica for this purpose. A mixture of salt and sand is heated to redness in an iron cylinder; steam is then passed over it, the temperature being kept up, the hydrochloric acid being conveyed away as fast as it is formed. When the process is complete, neutral silicate of soda remains, which is mixed with two-thirds of its weight of carbonate of soda, and heated to redness in a furnace. The resulting mass is dissolved in hot water. Carbonic acid is next passed into the liquor, when a gelatinous precipitate of silicate acid is thrown down, and carbonate of soda remains in solution.

Another process, the successful working of which depends entirely on the ingenuity and skill with which the plant is constructed, is that patented by Dyer and Hemming as long ago as 1838. When commercial carbonate of ammonia, which is really a mixture of carbonate and bicarbonate, is added in a state of fine powder to a solution of about the same weight of salt in three parts of water, the mixture being well stirred, in a few hours a white crystalline precipitate of bicarbonate is formed, chloride of ammonium remaining in solution. The solid bicarbonate is collected and separated from the mother-liquor by squeezing it in a press, whilst the chloride of ammonium is re-converted into bicarbonate by evaporating it to dryness, and treating as in the ordinary mode of preparing carbonate of ammonia.

The difference in value of soda as carbonate and bicarbonate is very great; the carbonate containing about 52 per cent of soda and the bicarbonate about 38 per cent, are of about the same value.

The chemistry of this process leaves little to be desired. The reaction is perfect and complete, and the whole of the salt is converted into bicarbonate.

The point on which, according to Dr. Hill, the chief interest should centre is, whether the bicarbonate can be obtained sufficiently free from alkaline chlorides to render it capable, by the removal of these hygroscopic substances, to enter the market as bicarbonate.

The grand stumbling-block which, in spite of the many fascinations attaching to this plan of decomposing salt, has hitherto prevented its achieving success, is the great difficulty of avoiding the loss of ammonia during the process, and of recovering it completely from the chloride of ammonium to renew the reaction. This is wholly and solely a question of apparatus. The patents for supposed perfection in the arrangement of modes of working have been very numerous, but as yet none have stood the test of continuous competition with Le Blanc's process. The difficulties should not be insuperable, but require to be viewed from the three points of view of the chemist, the engineer, and the mechanician. Individually each has been unsuccessful, but by combined action they would probably render this mode of carbonating salt one of our great industries.

The latest patent is one taken out by Mr. James Young (so well known for his connection with the mauufacture of paraffin). As well for the chemical skill as for the ingenuity displayed with the arrangements for working, this patent has enlisted strong sympathies in its favour.

Of the plans which have been proposed for obtaining soda by the decomposition of salt by oxalic acid, boracic acid, and phosphoric acid, it is unnecessary to speak, the reagents employed being far too costly to sustain the losses they must necessarily undergo in carrying out a manufacture on a large scale.

Sulphate of soda is but very slightly acted on by lime. Dr. Hill, who has recently made many experiments, never succeeded in obtaining more than 1 per cent of the soda in the sulphate, as caustic soda. When heated under steam pressure, the reaction is somewhat more complete. At the Jarrow Chemical Works, with the pressure of 40 lbs. per square inch, about 6 per cent of the soda was causticised, and with a pressure of 200 lbs., maintained for some hours, 13 per cent was obtained as caustic. Manifestly these amounts are far too small to augur any advantages from further research in this direction.

Caustic baryta, on the other hand, decomposes solutions of sulphate of soda of any strength, equivalent for equivalent; so that no concentration of the liquors is necessary, and the sodium is at once obtained as caustic soda; but the sulphate of baryta cannot at present be re-causticised except at so great a cost as to render its use commercially impossible. If, however, any chemist should hereafter arrange a cheap process for preparing caustic baryta, the black-ash furnace and the subsequent troublesome manipulations will speedily become things of the past.

Dr. Hill, in 1865, found that by boiling a mixture of carbonate of baryta with lime, in equivalent proportions, in solution of sulphate of soda under pressure, he obtained a complete decomposition, getting all the soda as caustic without a trace of sulphate, whereas if carbonate of baryta alone is used, as proposed Köbunter, only 75 per cent of the sulphate is causticised. But, as he remarks, though this process does away with the difficulty of obtaining caustic baryta, it is questionable whether the recovery of the carbonate of baryta from the mixture of sulphate of baryta and carbonate of lime, would be any cheaper than attempting to recover baryta in the caustic state from the sulphate.

(To be continued.)

NOTICES OF BOOKS.

Six Short Lectures on Experimental Chemistry. By J. EMERSON REYNOLDS, F.C.S. Dublin: Hodges, Foster and Co.

IN these lectures the author departs widely from the usual routine of elementary treatises. Instead of beginning with a detailed examination of the elementary bodies, he takes up a few substances—two only in the outset—and by their aid explains chemical action in its two great phases of combination and decomposition. The balance is appealed to almost from the first, and the student is led, by a quantitative examination of his experimental results, to the fundamental truths of constant composition and of combination in definite proportions. We believe that the author is right in the general plan he has adopted, and that instruction of this nature would greatly facilitate the acquisition of clear and distinct ideas of the leading facts and laws of chemistry.

A Manual of the Chemistry of the Carbon Compounds, or Organic Chemistry. By C. SCHORLEMMER, F.R.S. London: Macmillan and Co.

DR. SCHORLEMMER is doubtless well known to many of our readers, both as a successful teacher of chemistry and as a meritorious investigator. The present work is, in its arrangement, based upon the lectures on organic chemistry which for the last few years the author has delivered at Owens College, Manchester. Of course, no single volume could contain a description of all the carbon, or, as they were formerly called, organic, compounds. Those only, therefore, are here described which have either a theoretical interest, or which are medicinally or industrially important.

After a brief introduction, in which the author refers to the erroneous assumption, now abandoned, that there existed an essential difference between organic and inorganic bodies, we find an account of the chemical nature of carbon and of the constitution of its compounds. Next follows a brief, but clear, description of the ultimate analysis of carbon compounds, illustrated with the necessary engravings. Curiously enough, in the determination of nitrogen by Will and Varrentrapp's method the old charcoal combustion-furnace is figured. Instructions are also given for the determination of vapour densities. Sections follow on the determination of the molecular formula; on empirical, rational, and constitutional formulæ; on isomerism; on the physical properties of the carbon compounds, with some useful remarks on fractional distillation.

The author then proceeds to a systematic description of the carbon compounds, arranged under the following groups:—Oxides and sulphides of carbon with the cyanogen compounds; the fatty substances, and the compounds nearly connected with them; the compounds richer in carbon than the fats; and, lastly, a number of animal and vegetable compounds whose relations to other bodies are not determined.

The work may safely be pronounced a useful addition to what may be called the educational department of our chemical literature.

Will a Sewage Farm Pay? By Lieutenant-Colonel A. S. Jones, V.C. London: Longmans, Green, and Co.

Is there any causal connection between the possession of the Victoria Cross and a propensity for sewage irrigation? Does the love for encountering dangers which enables its possessors to earn so honourable a distinction in war urge them, in time of peace, to attempt the solution of one of the most difficult problems of the day? Or are our gallant soldiers carried away by their experience of normal irrigation in India? If so, we fear that they overlook certain important distinctions between the two cases.

The irrigation farmer or planter in India allows the water to flow upon his land when, and only when, the state of the weather and the condition of his crops make it requisite. The sewage-irrigation farmer in England has no such privilege. In seed-time or harvest, in summer or winter, the sewage flows from the town, and must, by contract, be admitted upon the land. If excluded from one field, as being unnecessary or hurtful, it must flow over others. Again, the climate of India is characterised by long periods of drought, and though its total average of rainfall is copious, its amount of evaporation is very great. Hence, irrigation is there of the highest value. At home these conditions are very different. Our evaporation is comparatively trifling; our rainfall is, in ordinary seasons, so distributed, that injury to crops from lack of moisture is rare. If we look to the two crops on which the food of the English people mainly depends—wheat and potatoes—we may say that, for one season when these are injured by deficiency of moisture, there are twenty seasons where they are damaged by its excess. We fail, therefore, to see that there is in England any great sphere for irrigation. Cabbages and rye-grass, when produced on the small scale, may find a market. But if London, Liverpool, Manchester, Leeds, and Birmingham decide on adopting the irrigation system, these kinds of produce would not easily find purchasers.

There is another point which we must not overlook. Since February, 1872, when Colonel Jones commenced his experiments in sewage-farming, we have had no severe and prolonged frosts. This, unless the climate of England has lately changed, is a fortuitous circumstance upon which it is impossible to reckon in perpetuity. Leaving out of consideration those rare seasons when the thermometer has remained below 32° F. for twelve or thirteen consecutive weeks, we must remember that severe frosts of a fortnight's duration are nothing uncommon. At such times irrigation must completely break down. The sewage, unable to soak into the frozen earth, must spread over the surface, finding its way into rivers, flooding public roads, and occasioning serious inconvenience to the public.

The author expresses the opinion that there are "few more healthy residences than a well-managed sewage farm." Perhaps, when his experience has become greater, his views on this subject may be modified. Officia documents, quoted in the Chemical News, recently brought to light the fact that in India irrigation exercises an unfavourable influence upon the health of the locality, and that a committee appointed to take this matter into consideration recommended that belts of trees should be planted between irrigation lands and the adjacent villages. If mischief thus arises from occasional irrigation with clean water, surely constant irrigation with sewage cannot be less dangerous. We have never maintained that sewage-farming must, under all circumstances, prove a commercial failure. The brief experience of Colonel Jones is as far from demonstrating that irrigation is the best mode of dealing with sewage as the proverbial "one swallow" is from making a summer.

The Constants of Nature. Part I.—Specific Gravities; Boiling- and Melting-Points, and Chemical Formulæ. Washington: Published by the Smithsonian Institution.

This work gives, in parallel columns, the names of the bodies, elementary or compound, their formulæ, specific gravities, boiling- and melting-points. At the foot of each page are given the authorities. There is a list of the principal papers used in compiling the tables, an explanation of abbreviations, an appendix giving determinations made subsequent to the completion of the body of the work, and an index of substances.

These tables will prove very useful to chemists and physicists.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—It is now three years ago that I endeavoured, through the medium of your valuable paper, to obtain from Dr. Voelcker an expression of opinion as to the comparative values of the phosphates of alumina and lime as fertilisers. Feeling interested in manures, my attention was naturally drawn to the very favourble report generally which Dr. Voelcker wrote on Price and Forbes's patent process for the utilisation of sewage, and to the analysis of the sewage precipitate obtained by the phosphate sewage company, as well as to the high money value which Dr. Voelcker assigned to the manure. My letters remained, however, unanswered, and I should not have encroached further upon your valuable space had it not been for an article on "Commercial Analyses," by Mr. Stanford, which appeared in the Chemical News, vol. xxix., p. 190, in which the author revives the subject, and remarks that "either Dr. Voelcker has made a mistake and will not admit it, or else phosphate of alumina has a manurial value which has not hitherto been assigned to it; and, if this be the case, why is it a drug in the market?" My opinion on the subject is that which I expressed three years ago, and subsequent events have proved that I was justified in asking Dr. Voelcker whether he had not overestimated the worth of the precipitate in question. Either the phosphates of alumina and iron are of value as a manure, or they are not: if they are, why then are they drugs in the market? if they are not, Dr. Voelcker must admit he made a mistake in valuing at £7 7s. per ton a manure which contained all its phosphoric acid fixed with those bases.

As no reply has been vouchsafed by Dr. Voelcker, I am sure your readers will agree with Mr. Stanford that it is to be "regretted" that Dr. Voelcker should persist in refusing to retract an erroneous opinion, or should decline to show that the substance in question has the money-value he assigned to it, and in what sense he considers it "equivalent to 62 per cent of tribasic phosphate of lime."—I am, &c.,

Superphosphate.

London, May 12, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 30, 1874.

Apparatus Designed by M. Moncoq for Transfusion of Blood.—M. Bouley.—It consists essentially of a glass pump, the piston of which is moved by a toothed wheel turned alternately (a quarter of a turn) in opposite directions. The return of blood by the orifice of entrance is prevented by valves. To the side of the lower part is connected a glass funnel for receiving the blood as it comes from the vein, and which the pump immediately sends into a tube communicating with the vein of the person operated on. In another modification a small cupule is applied, inverted like a cupping-glass, to the vein from which the blood is to be taken (after lancing), and the blood flowing out is immediately forced by the pump into the vein of the other person.

Integration of Equations with Partial Derivatives of the Second Order.—M. Pesait.

Artificial Production of the Phenomena of Gaseous Thermo-Diffusion of Leaves by Moist, Porous, and Pulverulent Bodies.—M. Merget.—The author first mentions some experiments as showing the influence of humidity in thermo-diffusion in a leaf of *Nelumbium*. Such a leaf, fresh, with cut petiole immersed in water, may retain its thermo-diffusive power entire days, gradually losing it, however, as it dies. By moistening again the power is restored. The thermo-diffusive process is enunciated as follows:—In a moistened porous diaphragm, whose two faces are subject to unequal evaporatory movements, this inequality causes diffusion in one and the same gas originally in the same state on both sides. The gaseous current then arising proceeds from the face which evaporates more to that which evaporates less. M. Merget constructs "thermo-diffusers" for showing this. They consist of a plate-shaped vessel of porous baked clay, and containing pieces of the same clay, the varnished neck having an abductor tube fitted to it. Moisten the surface with ordinary water, and put the end of the tube in water, then gradually heat the vessel in a stove. At pretty low temperatures (30°) it begins to give passage to the exterior air, and the diffusive movement progresses with the temperature. Thus introduced under pressure, the air passing through the vessel is liberated in bubbles from the abductor-tube. This liberation is not the effect of expansion and condensation of the interior vapour; for it occurs, and may even be accelerated, when the thermo-diffusor is filled with quicklime, or when it is heated to a temperature under 100°, and the abductor-tube placed in boiling water. The results are independent of the nature of the porous body employed and of the moistening liquid, provided this is volatile. Pulverulent substances also show thermo-diffusive properties when moistened and sufficiently condensed by sinking. An arrangement for illustrating this is described. Thus the ground, in certain conditions, is favourable to the phenomenon. When moist and strongly heated by solar radiation its surface gives access to the external air, which penetrates from the hotter to the colder layers.

Method of Photographic Enlargement for Astronomical Observations.—M. Zenger.—To obtain an image of the sun he replaces the lenses by a mirror with long focus, giving images 25 to 50 m.m. diameter. The insignificant spherical aberration can be corrected by a new method applicable to all photographic processes. It was suggested to him by looking at Rutherford's photographs with a Galilean telescope, which showed minute craters that were not visible to the naked eye, nor with aid of a lens. He concluded the aberration was corrected through the combination of positive with negative lenses. Suppose we have photographed the sun or the moon with an astronomical telescope, in which the remaining aberration is $+\lambda$, and that we use another optic system with total aberration $-\lambda^1$, lastly that the enlargement produced by this system is m, then the remainder of aberration of the image will be $L=\lambda-m^2\lambda^1$. Hence we may get images with an aberration of $\lambda=m^2\lambda^1$, or with a negative aberration $m^2\lambda>\lambda^1$. We may, then, photograph this image with a negative aberration, using a concave mirror or an aplanetic lens, giving the same aberration $L=\lambda-m^2\lambda^1$, but positive. With this method of successive enlargements of photographic images of the moon and sun the author obtained images 110 inches in breadth. This for the moon is a magnification 2400 times. All details come out very distinctly. The author proposes his method should be employed in the approaching transit measurements. He would observe the passage of Venus by a given point of the sun's disc, instead of contact with the border. He considers that the transits of Mercury, which occur more frequently, might also be taken advantage of.

Electric Automatic Whistle for Locomotives.—MM. Lartigue and Forest.—The lever of the whistle is wrought by an electro-magnet. On passage of a current in a certain direction the magnet lets go the lever, and the whistle sounds. The apparatus is connected by insulating wires with a metallic brush projecting below the locomotive. At a short distance in front of the sight signal there is a metallic plate between the rails, which, when the signal is turned in the position for stoppage, is connected with a source of electricity. On passage of the brush over the plate the current flows and the whistle sounds. It continues to do so till adjusted again by the engine-driver. The Chemin de fer du Nord have used the system eight months, and with satisfactory results.

Use of Luminous Signals in Geodetic Operations.—M. Laussedat.—Suppose a telescope directed, in a station at which we are, to another to which we wish to send light. Place at the focus a diaphragm with very small aperture, such that the field of vision only includes the building (tower or the like) in which the other observer is. Remove the eye-glass, and put behind the diaphragm in the axis of the telescope, first, a convergent glass, then a luminous source, the conjugate image of which produced by the glass falls exactly in the opening of the diaphragm. The luminous bundle will then fall on the building included in the field of vision, and the light will be invisible to any that are out of this field. The distant observer will perceive this bundle in full. He will see the object-glass of the emitting telescope illuminated throughout its surface, and the greater the diameter of this the further will the signals be perceptible. A simple petroleum lamp will give signals visible to the naked eye at 36 kilometres.

The Analysis of a Closed Condenser proves that the Electric Induction does not Traverse the Conducting Masses.—M. Volpicelli.

Movement of Air in Pipes.—M. Bontemps.—When a pipe is transmitting air, and one point of it is heated, then on either side of this point the modification in the pressure is inverse; before the point the pressure increases, behind it falls. Hence if two points are equally heated the pressure in the middle of the interval is not altered. M. Bontemps points out the analogy of the experiment he describes with that of introducing an electromotive force into a galvanic circuit. The consequent modification in distribution of electric tensions, according to Ohm's law, is of the same nature as the change of pressures in the current of air. He proposes to show that the analogy is more profound, and that the methods of measuring the electric current apply to determination of the intensity (quantity and weight per second) of an air current.

Experimental Researches as to the Influence of Changes in Barometric Pressures on Phenomena of Life. (Thirteenth note.)—M. Bert.—The author describes experiments on man. He went into his decompression apparatus, and caused the pressure to be reduced to 450 m. in about half-an-hour; it was kept between this and 408 m.m. (corresponding to heights of 4100 and 5100 m.) for an hour and ten minutes; then the normal pressure was gradually restored. At 450 m.m. he experienced mountain sickness; felt heavy, weak, and sick; with fatigue of sight and general indifference. On raising the right leg it was seized with convulsive tremblings, which extended to the left leg, and continued some minutes. The face was congested, &c., he was unable to whistle. But the interesting point in the experiment was this:—He had taken in with him a small vessel of pure oxygen. When the pressure was 450 m.m., and the pulse had risen from 62 to 84, he made an inspiration of oxygen; immediately the pulse fell to 71. It rose again to 100 on his making an effort with the spirometer, but a fresh inspiration of oxygen brought it to 70. A like result followed other inspirations. Through inhaling the oxygen the mountain sickness disappeared. These facts have lately been utilised by MM. Croce-Spinelli and Sivel in a balloon ascent.

Action of Ammonia upon Aceton.—W. Oechsner and A. Pabst.—The authors conclude that in the action of ammonia upon aceton there is formed not a trace of aldehyd or of methylamin, and that the product of the reaction of these two bodies is the acetonin of Stædeler.

On Egyptian Blue.—H. de Fontenay.—The specimens examined gave on analysis—

Silica	70·25
Oxide of copper	16·44
Iron and alumina	2·36
Lime	8·35
Soda	2·83
	100·23

without a trace of cobalt. By mixing—

White sand	70
Black oxide of copper	15
Chalk	25
Carbonate of soda, dry	6

the author obtained, after due ignition, a blue frit quite analogous to the azure of the ancients. It is necessary to raise the temperature gradually to 1000°, and to maintain it at that point for some time without allowing it to rise higher. If the heat becomes excessive the colour changes to a dirty green, and then to brown.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 12, March 19, 1874.

In a paragraph, the authority for which is not given, mention is made of explosive diamonds in South Africa. The explosion generally takes place during the first week of its exposure to the air, but cases have occurred of explosion three months afterwards. By coating the diamonds with tallow these accidents may be prevented, but a diamond which can only be preserved in this manner is evidently valueless.

Megass, the residual matter of the sugar-cane after extraction of its juices, is found to be an excellent material for the paper-maker.

No. 13, March 26.

New Manure.—MM. Béllinet and Martinet state that they have succeeded in converting the nitrogen of the air into ammonia without expense, without chemical manipulation, and even without human intervention at all, by the use of certain bituminous schists. These schists contain all the elements necessary for the growth of plants in much larger proportions than farm-yard manure. Sulphide of carbon is produced at the same time, and is said to be the only remedy for the Phylloxera.

No. 15, April 9.

Gilding on Zinc.—C. D. Braun dissolves sulphide of gold in sulphide of ammonium, deposits a layer of gold upon pieces of clean zinc plunged into it, the air being excluded as far as possible.

Aluminium Silver.—The following alloy is distinguished by its beautiful colour, and takes a high polish:—

Copper	70
Nickel	23
Aluminium	7
	100

Use of Potash as a Manure.—Boutard and Dejoux recommend potash to destroy the Phylloxera, and suggest at the same time that the soil of the vineyards must be exhausted of this alkali.

Nos. 16 and 17, April 16 and 23.

These numbers contain no original chemical matter.

Reimann's Farber Zeitung, No. 7, 1874.

This number contains articles on the production of "Paris black" upon silk; on grinding indigo; receipts for a fast Nicholson blue on wool; for a royal blue on woollen cloth; on dyeing wool with indulin and bengalin; on chrome-orange upon cotton.

Oil Mordants for Cotton-Dyeing.—Mix 6 lbs. of olive oil with 8 lbs. of alcohol, and add 8 lbs. of boiling water, with constant stirring. Add finally ¾ lb. of oil of vitriol, previously diluted with water (? how much), and stir well.

Next follow a receipt for finishing cottons; for printing aniline green upon calico; for stripping Schweinfurt green and Nicholson blue from worn tarlatanes; for a brown on woollen garments; and for dressing silks.

A. W. Hofmann has found among the distillation-products of beech-tar which pass over last, a colourless oil, which boils at 270° C. It congeals with the fixed alkalies and with ammonia to crystalline salts, and, in contact with bichromate of potash, turns rapidly brown, and after a few moments forms a felted mass of violet crystals. The latter dissolve in sulphuric acid with a corn-flower blue, and display all the properties of cœrulignon. The oil may also be oxidised to a substance which forms large yellow crystalline needles, and dissolves in sulphuric acid with a crimson colour.

No. 8, 1874.

This number contains receipts for a variety of colours on wool, woollen yarn, and shoddy; for a cheap black on old silk; for printing a black and white design on a madder-red ground; and for a light brown and a fast madder-red on cotton.

No. 9, 1874.

This number contains a notice of the new Industrial Society of Rouen, which has just published its first *Bulletin*, containing an interesting article on calico-printing.

There are receipts for topping vat- and alkali-blues on wool with aniline violet; for a green upon wool with Nicholson's blue, and for the same shade upon woollen goods with cotton warp; for printing deep violet upon cotton yarn (warps); for a vat-blue upon cotton-yarn topped with logwood-blue; for a madder-rose on cotton and linen; for heavy browns on silk; a continuation of the article on dyeing and finishing plush; and a dressing for coarse linen.

Saffron Substitute.—This is a new trade-name for the binitro-cresylate of potash, otherwise known as Jaune d'Or. It agrees in its chemical constitution with Victoria orange, but the properties of the two bodies are not identical.

Dyeing with Mahogany Sawdust.—A Mr. C. Dreyfuss, a correspondent of the *Farber Zeitung* residing in England, has patented mahogany sawdust as a ware for dyeing and printing browns on cotton. He mordants with tin, and uses a little lime and glue in the dye-beck.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of bichromate of potash, or salts of similar commercial properties. Alexander Gow, Ladbroke Grove Road, Kensington, Middlesex. July 18, 1873.—No. 2472. 1st. Using ground carbonate of lime (unburnt) instead of quick-lime. 2nd. Using a compound salt formed of carbonate of potash with carbonate of soda. 3rd. Using a compound salt formed of sulphate of potash with sulphate of soda and carbonate of barytes, or using a compound salt formed of sulphate of potash with carbonate of barytes.

Improvements in the production of citric acid, tartaric acid, and alcohol. Antonio de Saldanha Albuquerque e Castro, Condi de Penamacor, Antonio Paes de Sande e Castro, both of Lisbon, Portugal, and Thomas Smith Hopcraft, Mincing Lane, London. July 19, 1873. —No. 2484. This consists in the use of the "tamarinha" plant, which is cut, preferably when in a green state, and is subjected to pressure to extract the juice therefrom, which is afterwards operated upon by the usual appliances or machinery by which citric acid, tartaric acid, and alcohol are generally made.

Improvements in the manufacture of steel. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Victor Honoré Eugene Gallet, Paris). July 19, 1873.—No. 2487. This invention relates to a peculiar process and composition for obtaining cast-steel or steel of cementation of the best quality from ordinary iron, iron puddled with coke or with wood, puddled steel, Bessemer steel, cuttings of old steel springs, and in general all steels obtained directly either from the ore or from cast-iron. To obtain cast-steel of the best quality from the class of iron above mentioned, it is proposed in general to employ a cement or composition composed of the following ingredients in about the proportions given:—

Alumina	0·50 to 1	part by weight.
Clay of a highly aluminous character	12 to 20	„
Powdered wood-charcoal, soot, and lamp-black	50	„
Carbonate of lime..	38 to 42	„
Carbonate of potash	18 to 30	„
Carbonate of soda..	2	„
Caustic potash	0·50 to 1	„
Oxide of manganese	4	„
Resin..	4 to 5	„
Common salt	1	„
Sal-ammoniac	0·50 to 1	„
Borax	0·50 to 1	„
Water	About 10 per cent of the weight.	

An improved cement for joining leather, wood, china, glass, and other articles. Francis Harrison, Stockport, Chester. July 19, 1873.—No. 2488. I first take 1 lb. of acetic acid, and dissolve therein, in a jar or other vessel, ¼ lb. of gelatin, ¼ lb. of fish-glue, and 1 oz. of isinglass. The acid will dissolve the other ingredients cold, but the application of heat hastens the process. This I call solution No. 1. I then take ¼ oz. of resin, and place it in a corked bottle with 2 ozs. of spirits of turpentine till dissolved; or I take the same quantity of gum mastic, and dissolve it in spirits of wine; but this is more expensive, so I prefer the former, which I call solution No. 2. When thoroughly dissolved I take these two solutions, and mix and stir them well together. For shoemaking purposes, I sometimes add a third solution (No. 3), composed as follows:—¼ lb. of gutta-percha, dissolved in ¼ lb. of sulphate of carbon. This is to be put in a bottle tightly corked, and, when it is dissolved, add to it 2 ozs. of the cement above named, composed of solutions No. 1 and No. 2 mixed together.

Improvements in the treatment of sewage and cesspool water. William White, Thurlow Road, Hampstead, Middlesex. July 24, 1873.—No. 2532. This Provisional Specification describes treating the sewage, &c., with chloride of calcium, and sometimes with sulphate of iron and lime.

Improvements in treating sewage and other foul liquids for the economical removal and utilisation of soluble and suspended impurities contained therein, and in apparatus for the same. James Robey, sugar refiner, Manchester. July 25, 1873.—No. 2534. The object of this invention is to treat sewage and other foul waters for the purpose of purifying the same by a combined system of precipitation and filtration. I take raw peat, and well macerate with water to a fluid consistency, and mix the same in the proportions stated with the sewage or other foul liquid. Perchloride of iron or other flocculating or coagulating agent is then added, and the whole run into a tank fitted as described, with upright filtering frames of any convenient shape, made by preference of bamboo or cane, and covered with any suitable filtering material, whereby an enormous area of filtering surface is obtained in proportion to the area of ground covered by the tank. The clear effluent water I then pass through beds of any suitable charcoal to remove the soluble impurities, by preference using that made from street sweepings, and described in the specification for which Letters Patent were granted to the present applicant and George Frederick Chantrell, No. 957, 1873.

Improvements in treating cotton waste, hair, wool, and oleaginous seeds for the removal of oil or grease; also applicable for the same purpose to hides and skins, and in preparing the same for tanning, and for preventing mildew in cotton and other fabrics, and in apparatus for such purposes. Arthur Granville, tanner, and Edwin Eli Johnson, pharmaceutical chemist, both of Manchester. July 25, 1873.—No. 2540. The features of novelty in this invention consist in so treating cotton waste, hair, wool, hides, skins, and oleaginous seeds with petroleum spirit, benzoline, or other similar product of petroleum having an affinity for grease, and in suitable apparatus, as to remove and preserve all the oil, grease, or other fatty matter from the same; and in the case of skins and hides to prepare the same for tanning, also in treating hides and skins for the removing of the hair or wool by the application of sulphide of lime as described, and in submitting cotton and other fabrics to the action of petroleum spirit for the prevention of mildew.

Improvements in separating zinc, copper, or other ores or materials from carbonate of iron, and in apparatus employed therefor. Frederick John King, merchant, Bishopsgate Avenue, London. July 29, 1873.—No. 2574. My invention consists in effecting the separation of ores, such as zinc or copper ores from carbonate of iron, by first subjecting the ores or materials to be separated to the action of heat in closed or partially closed retorts, or in any furnace in which air is practically excluded during the roasting process, whereby the carbonic acid is removed from the iron, the iron being thereby changed to a magnetic state; and then passing the roasted ores over a revolving wooden wheel or roller, on the circumference of which are placed rings of iron or steel, each alternate ring being in contact with the opposite poles of a number of magnets inserted in the wheel or roller, a continuous band of silk or other textile fabric, or any material through which the magnetic power will pass, being passed around this wheel by means of a second wheel or roller, or other convenient arrangement, drawn away from contact with the magnetic wheel or roller for a short distance during its revolution. The ores prepared as above described being passed through a hopper, or otherwise passed upon the band around the magnetic wheel or roller, the magnetic particles are carried to the point where the band leaves the magnetic wheel or roller, and then drop into a receptacle for the iron, while the non-magnetic zinc, copper, or other ores or substances fall from the band into another receptacle.

Improvements in the treatment of sulphur ores. Alexander Angus Croll and David Croll Dalgairns, civil engineers, Coleman Street, London. August 1, 1873.—No. 2608. Sulphur ore is found largely combined with other foreign matters, and, by the process generally adopted for its separation by heat, a very large percentage of the pure sulphur is lost, and very injurious effects are produced on surrounding vegetation by the escape of the noxious volatile products. To remedy these evils, the portions of sulphur ore mixed with other foreign matters are separated from such as may be generally of a purer quality, and these impurer or mixed parts are reduced to a pulverised state, and thoroughly mixed, by agitation or otherwise, with water, and separation of the particles is effected according to their different specific gravities, and the sulphur becomes separated from the other matters. The particles so separated according to their different specific gravities may be drawn off at different heights from a suitable reservoir. Muriatic or other acid may be employed to combine with the foreign matters and assist separation.

NOTES AND QUERIES.

An Observation.—Some time ago I made a solution of phosphorus in bisulphide of carbon. After a few weeks, there had collected at the bottom of the bottle a bright yellow flocculent precipitate, which gradually increased in amount. Attempting to remove the stopper for the purpose of examining the precipitate, I found it immovable, and, on the application of a little extra force, the head of the stopper broke off. I then took the bottle to the top of the sea-wall, and threw it with some violence down on a stone just projecting out of the sea. The moment the bottle broke, the mixture took fire, with a slight explosion, and a cloud (presumably of phosphoric acid) was produced. This seems the more strange because the original solution, when poured on blotting-paper, always required several seconds to ignite.—John E. Wright, Penzance, May 18, 1874.

Valuation of Salt-Cake.—Mr. Walter Tate, in his last letter on salt-cake, considers the method for testing free HCl which Mr. Simmonds was, I believe, referring to in a former communication, as decidedly objectionable, because the loss of weight is due to an equivalent amount of H_2SO_4, and not to HCl itself. But what hinders him, may I ask, to calculate the loss of H_2SO_4 into the formula o HCl? —J. O., Bordeaux, May 18, 1874.

MEETINGS FOR THE WEEK.

Tuesday, 26.—Civil Engineers, 8.
—— Anthropological Inst., 8.
Wednesday, 27.—Society of Arts, 8.
—— Geological, 8.
Friday, 29.—Royal Institution, 8.

TO CORRESPONDENTS.

J. Nermos.—Write to Messrs. Negretti and Zambra, Holborn Viaduct.

Luctor.—1. Nitrog [illegible] ressible. [illegible] more intensely.

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Royal Polytechnic.—Notice to Everybody.—If you want SCIENCE, you can have it. If you want INSTRUCTION, you can have it. If you prefer AMUSEMENT; you can have it. You can have either, or all three, by paying the Admission Fee of One Shilling!—The Easter Programme contains:—1. ECONOMY OF GAS; SEBOHR'S New Apparatus.—2. Something more about SUGAR; New Lectures, by Professor GARDNER.—3. The WONDERS OF ACOUSTICAL SCIENCE; New Lecture, by Mr. J. L. KING.—4. LATEST NEWS FROM ASHANTEE; New Lecture, by Mr. B. J. MALDEN.—5. SIR WALTER RALEIGH'S DREAM! QUEERER THAN EVER! This Historical Incoherency has been re-written by Dr. CROFT, and will be produced with new Songs, Dresses, Effects, and Appointments. Daily at 4 and 9, by Mr. J. OSCAR HARTWELL.—Many other Entertainments.—Open 12 and 7. Carriages at 5 and 10.

THE CHEMICAL NEWS.

Vol. XXIX. No. 757.

ON THE ESTIMATION OF ALUM (ALUMINA) IN BREAD.

By A. DUPRE, Ph.D.

The separation of pure alumina from the constituents of bread-ash, for the purpose of accurate quantitative estimation, is a tedious and somewhat difficult analytical process. Fortunately, this is quite unnecessary, if our object is simply to estimate the amount of alumina contained in a bread-ash. For this purpose, it is sufficient if we separate the alumina in the form of a compound of constant composition. The phosphate of aluminium is such a compound, and admits of easy and perfect separation from the phosphates of magnesium, calcium, and iron, by which it is accompanied in bread-ash. It has, besides, the advantage of weighing about two-and-a-half times as much as the alumina corresponding to it. The process is carried out as follows:—

One hundred grammes of bread (crumb only) are carefully incinerated in a platinum dish. The ash is fused, in the dish, with about three times its weight of pure carbonate of sodium, or of a mixture of the carbonates of potassium and sodium in equal proportion. The incineration and fusion are best performed in a muffle. The fused mass is dissolved in hydrochloric acid, and the solution is evaporated to dryness. The residue is re-dissolved in acid, and the silica filtered off as usual. To the filtrate ammonia is added until a slight permanent precipitate is produced, which is then re-dissolved by about six drops of strong hydrochloric acid. A slight excess of acetate of ammonium is now added, and the mixture is set aside overnight. Next morning, the precipitate formed is filtered off, washed, and re-dissolved in hydrochloric acid. The solution is boiled for a few minutes with a small quantity of bisulphite of sodium, an excess of caustic soda is added, and the boiling continued for a few minutes longer. The precipitate, chiefly magnetic oxide of iron, is filtered off, the filtrate is rendered feebly acid by hydrochloric acid, and acetate of ammonium added in slight excess. After standing overnight, the precipitate, now consisting of pure phosphate of aluminium, is collected on a filter, washed, dried, ignited, and weighed. By multiplying its weight in grammes by 542, the number of grains of potash alum contained in 2 lbs. of the bread examined, or rather the number of grains of alum corresponding to the amount of alumina present in 2 lbs. of the bread, is obtained. Instead of separating the iron as above, we may also re-precipitate the two phosphates a second time by the addition of acetate of ammonium, and weigh them together. The iron contained in the precipitate is then estimated by a standard solution of bichromate of potassium, and the amount of phosphate corresponding to it subtracted from the total, leaving, of course, the amount of phosphate of aluminium.

In precipitating the phosphates of iron and aluminium in the above manner, from a solution containing a large proportion of phosphate of magnesium, slight traces of this latter are always carried down, even if the precipitation takes place in the cold. In order to remove this impurity, it is necessary to dissolve the first precipitate and re-precipitate it a second time, as above directed. If the precipitation takes place at the boiling temperature, the phosphates of both magnesium and calcium are partially precipitated.

It has been stated that, during the evaporation of a solution containing alumina and hydrochloric acid, chloride of aluminium is volatilised. It has further been asserted that alumina is dissolved, during the evaporation of the acid solution, in a porcelain dish. I have found both these assertions to be without foundation. Among many experiments made to test these points, I may mention the following:—Three equal portions (50 c.c.) of a dilute solution of alum were taken. In the first, the alumina was estimated directly. To the second and third portions 3 grms. of carbonate of sodium were added (about the amount used for fusion with the bread-ash), after which they were acidified with hydrochloric acid, and evaporated to dryness over an argand-burner in a platinum and porcelain dish respectively. To the dry residues half an ounce of strong hydrochloric acid was added; this was again evaporated, and the process repeated twice more. Finally, the alumina in the residues was estimated. The following are the results:—

1st portion contained 0·688 grm. of alum.
2nd " " 0·690 "
3rd " " 0·688 "

In conclusion, I give, in the tables below, the results of some experiments made with various samples of bread and flour to which I had myself added different proportions of alum. These tables will, I believe, show that both the processes described above leave little or nothing to be desired on the score of accuracy, and both are easy of execution. It will be seen, however, that both the bread and the flour contained a small amount of alumina. (The two samples of flour used were bought at shops widely apart.) Whether this was due to an adulteration of the flour, or whether it represents a normal constituent of the flour, I have not been able to ascertain. However this may be, I am of opinion that no baker should be punished in whose bread the amount of alumina found corresponds to less than 10 grains of potash alum in the 2-lb. loaf; unless, indeed, there is direct evidence of adulteration by alum entirely independent of the result of the analysis.

Table I.—100 grms. of bread taken.

No.	Weight of Mixed Phosphates.	Phosphate of Iron.	Phosphate of Aluminium.	Corresponds to Alum in 2-lb. Loaf.	Alum added to 2-lb. Loaf.	
					Calculated.	Found.
	Grm.	Grm.	Grm.	Grs.	Grs.	Grs.
1.	0·0490	0·0114	0·0376	20·38	16·64	14·53
2.	0·0373	0·0114	0·0259	14·04	8·42	7·18
3.	0·0308	0·0128	0·0180	9·76	4·13	3·90
4.	0·0236	0·0128	0·0108	5·85	0·00	—

Table II.—80 grms. of flour taken.

No.	Phosphate of Aluminium Found.	Corresponds to Alum in 2-lb. Loaf.*	Alum added to 2-lb. Loaf.*	
			Calculated.	Found.
	Grm.	Grs.	Grs.	Grs.
1.	0·0442	23·96	19·19	17·89
2.	0·0200	10·84	5·75	4·74
3.	0·0112	6·07	0·00	—

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON THE PHENOMENA OF LIFE.

M. Bert has lately brought before the Paris Academy some additional facts in connection with this subject.

He had shown that animals subjected in closed vessels to pressures between 2 and 10 atmospheres died from poisoning by carbonic acid, which they themselves produced. He has further studied these toxical effects.

For sparrows, the law was that the animals died when the centesimal proportion of carbonic acid in the air, multiplied by the number of atmospheres, gave a product varying from 24 to 28. The same figure is obtained, and the same symptoms occur, when a sparrow dies in an atmosphere at normal pressure, and sufficiently rich in oxygen for the animal to have always enough at its disposal.

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* On the assumption that 80 grms. of flour give 100 grms. of bread.

Accordingly, with a view to studying the effects in question, he made dogs breathe in a caoutchouc bag, containing about 50 litres of super-oxygenated air at ordinary pressure. Death took place in four or five hours, when the air of the bag contained 35 to 45 per cent of carbonic acid.

The phenomena were, briefly, as follows:—

(1). The arterial blood contained abundant oxygen till death (when the gas-volume was 10 or 12 per cent that of the blood); the carbonic acid increased, but less and less rapidly; near the end it had reached the large proportion of 110 to 120 volumes, not far from the limit of saturation.

(2). The number of respirations quickly diminished, without proportional increase in depth.

(3). The pulsations fell still more rapidly, but continued some minutes after breathing ceased. The cardiac pressure was high all along.

(4). The temperature fell with wonderful rapidity, being at last in the rectum 24° or 28°, while the surrounding temperature was 15° or 18°.

(5). When the arterial blood contained about 80 volumes of carbonic acid, the animal became insensible, except in the eye, which did not lose sensibility till 100 volumes. The animal was quiet throughout.

(6). The motor nerves and muscles retained their properties after death.

(7). The tissues were charged with carbonic acid; muscles, *e.g.*, which usually contain 15 to 20 volumes of the gas, being found to have about 60. The urine contained even 100. The same phenomena were obtained with compressed air.

A comparative experiment was made as follows:—Four sparrows were placed in closed vessels—A in air at 6 atmospheres, B in super-oxygenated air, C in ordinary air, D in air at ¼ an atmosphere. Analysis showed that 100 grms. of the bodies of these animals contained—A, 33 c.c. of CO_2; B, 36; C, 17; D, 0. D died from simple privation of oxygen, A and B by carbonic poisoning, C by ordinary asphyxia. In ordinary asphyxia, the part played by carbonic acid is to be considered as quite secondary; it does not greatly accumulate in the blood or tissues. It was observed that the maximum of carbonic acid in the blood was attained considerably before death.

With regard to poisoning by carbonic acid, M. Bert makes several remarks. The organism being nearly saturated with the gas, the latter acts on the nervous centres and causes death by cessation of the respiratory movements. The fact that no convulsive movement preceded death disproves the theory that the general convulsions in asphyxia, hæmorrhage, &c., are due to carbonic acid in excess in the blood or the tissues. They are due to the spinal cord being quickly deprived of oxygen.

From the curve expressing absorption of external oxygen, it appears that during the first hours this absorption is normal and regular, and yet the temperature diminishes; the intra-organic oxidations furnishing heat become less intense as the blood and tissues are charged with carbonic acid. The action of carbonic acid formed gradually by the organism itself is very different from that of the gas respired at once. M. Bert has previously shown that, if two young rats be placed, one in carbonic acid and the other in nitrogen, the heart of the latter continues to beat for more than a quarter of an hour, while that of the former is arrested in two or three minutes.

The persistence of the heart beats above referred to, and the maintenance of the cardiac pressure, removing all fear of syncope, appear to M. Bert to deserve the attention of surgeons, with reference to employing, as an anæsthetic, carbonic acid, produced by respiration in a closed vessel. At a moment when there was no danger of the animal's life, one might squeeze its paws, or pinch various members, without calling forth any sign of pain or reflex movement.

The facts hitherto communicated have all related to the animal kingdom. M. Bert has, however, extended his researches to plants.

He commenced with germination, the phenomena of which are closely allied to those of animal life. The seeds he experimented with were those of barley and corn (farinaceous albumen), and of cress and radish (no albumen.

Diminution of Pressure.—In dilated air, germination is slower as the pressure is less. The difference, as shown in the number of seeds germinating, begins to appear from a pressure of 50 centimetres. The inferior limit at which germination can take place is, for cress, about 12 centims., and for barley 6. At the latter pressure it was found, *e.g.*, that of twenty grains of barley only two germinated. They reached a height of 6 centims., while those sown at normal pressure measured 12. At 4 centims.' pressure there was no germination.

The grains thus kept without germination were not killed, but germinated, as usual, when restored to normal pressure.

Experimenting as to whether this disturbance of the germination was due to barometric pressure, or to the tension of oxygen alone, he found:—

(1). That germination in an air containing little oxygen, but at normal pressure, is less rapid than in ordinary air.

(2). That germination under low pressure, but in super-oxygenated air, is as rapid as in normal air at normal pressure.

(3). That germination may be obtained at a pressure of 4 centimetres by employing super-oxygenated air.

(4). That the inferior limit of germination observed by Huber and Senebier in air containing little oxygen almost corresponded to that which he had indicated for atmospheric pressure. Germination, according to them, ceased, in lettuce-seeds, when there was about ⅐th of oxygen. Now the 7th of 76 centims. is about 11 centims.; minimum tension for the seeds of cress.

Germination, then, takes place less quickly in expanded air, and this arises from the weak tension of oxygen.

Increase of Pressure.—Here it is necessary to distinguish experiments made with closed vessels, from those in which the air is so frequently renewed that it may be considered pure.

In the former case, there is added to the influence of compressed air that of carbonic acid produced. Now, for seeds, as for animals, the toxical influence of carbonic acid is measured by its tension, so that at 2 atmospheres the proportion which arrests germination is about 10 per cent, and at 10 atmospheres about 2 per cent. Curiously, the toxical tension of carbonic acid is expressed by nearly the same number for both plants and animals.

Consider, now, the effects of compressed air renewed morning and evening, and thus kept pure. Till 4 or 5 atmospheres there is little to note. From 5 atmospheres, it becomes evident that the compressed air is unfavourable to germination, especially in the case of barley. This germinates more slowly, and the sprouts are pale and thin. At 8 atmospheres the stem does not grow, but only the root. At 10 atmospheres, the seeds of cress do not sprout; and there is only a slight commencement of radicle from the seeds of barley.

If, after some days' confinement in compressed air, and when barley-seeds sown at the same time have given sprouts of 5 to 6 centimetres, the seeds are returned to normal pressure, those of barley are found to be dead—do not germinate; those of cress, on the contrary, commence to germinate after long delay.

If sprouts of barley or of cress in full growth are subjected to pressure, the barley stops and quickly dies; the cress resists much longer.

Here, again, analysis of the phenomenon shows that this remarkable action of compressed air is due to too great tension of oxygen. For—

(1). Seeds of barley and cress placed in super-oxygenated air at normal pressure behave like those in compressed air. Thus, at about 60 per cent it is difficult to note any difference; but about 80 or 90 per cent (corresponding to 4 or 4·5 atmospheres) it becomes evident that the barley-seeds are developed very much less than in ordinary air; the cress-seeds are less affected.

These facts confirm the results obtained by Huber and Senebier, and which some physiologists have questioned.

(2). If super-oxygenated air be employed under pressure, we have, *e.g.*, at a pressure of two atmospheres, for an air with 90 per cent of oxygen (oxygen tension $2 \times 90 = 180 = 9$ atmospheres), the same results as with 9 atmospheres of air.

(3). If compression be produced in air containing little oxygen, so that the tension of this gas does not exceed that of ordinary air at 2 or 3 atmospheres, the germination takes place regularly.

To sum up:—

(1). With diminution of pressure, germination takes place more slowly the lower the pressure. It ceases finally between 4 and 10 centimetres, without the seeds, thus kept inactive, dying. There is evidently an arrest of the oxidations necessary to development of the embryo, owing to the too weak tension of oxygen.

(2). With increase of pressure to 2 or 3 atmospheres, there seems to be a slight advantage for seeds in the compressed air; but, from 4 or 5 atmospheres, there is evident disadvantage, especially to seeds with farinaceous albumen. Lastly, at very high pressures, the seed is killed by being kept in the compressed air; it is also killed when subjected to compression after its development has commenced. This is due to the too great tension of oxygen retarding the oxidations, as in the case of animals. If the alterations in the compressed air be examined, it will be found that the consumption of oxygen has been much less than at normal pressure.

The present communication seems to offer a solution of certain important questions connected with the geographical distribution of plants, &c.

RESEARCHES ON THE FORMATION OF SUPERPHOSPHATE OF LIME.

By M. J. KOLB.

In the manufacture of superphosphate the reaction is generally supposed to take place in accordance with the following equation:—

$$PO_5,3CaO + 2(SO_3,HO) = PO_5CaO,2HO + 2CaO,SO_3,$$

and the fluctuating results are ascribed to incidental circumstances. The author considers that the reaction is less simple. If we take 1 equivalent of pure tribasic phosphate and 2 equivalents of sulphuric acid at 53° (Baumé ?), and mix them intimately, there is a rise of temperature of 120° to 150°, whether we operate on the large or small scale. Under such circumstances an acid phosphate cannot be formed for three reasons.

(1). Monocalcic phosphate, even in solution, if exposed to a temperature of 100° is partially decomposed, and gives a precipitate of bicalcic of pyrophosphate.

(2). Between 120° and 150° sulphate of lime becomes anhydrous, and then decomposes monocalcic phosphate, even in solution, absorbing the water necessary for the existence of the latter.

(3). If sulphuric acid is brought in contact with a mixture of monocalcic and tricalcic phosphates, it leaves the tricalcic untouched, and decomposes first the monocalcic phosphate. Therefore when sulphuric acid is gradually poured upon tricalcic phosphate, as is done on the large scale, the first portions of the acid phosphate formed would be in contact with sulphuric acid and be decomposed, even if they escaped the action of heat and of the anhydrous sulphate of lime. Deherain supposes that superphosphate is phosphoric acid mixed with sulphate of lime. Milliot and Joulie have already pointed out the existence of free phosphoric acid in superphosphates. On taking 100 parts of tribasic phosphate of lime and 95 parts of sulphuric acid at 53° we have the conditions of the following formula—

$$6(SO_3Aq.) + 2PO_53CaO) = 2PO_5 + 6(CaO,SO_3) + Aq.$$

Experiment gave 43 to 44 of free phosphoric acid, whilst the formula would indicate, theoretically, 45·7. Deherain would, therefore, be right if such proportions were employed, but as they give an unmarketable puddle, practical operations are based upon the formula—

$$2(SO_3Aq) + PO_5,3CaO.$$

If we take pure products, calculated upon this formula, and analyse the result, at first a few moments after mixture whilst the mass is still hot, and then at successive intervals of fifteen minutes or an hour, we find that the free phosphoric acid, at first very considerable, constantly decreases, whilst that of acid phosphate of lime progressively increases. It is then plain that phosphoric acid is formed at first, and that it is gradually converted into acid phosphate. If we triple the formula $2(SO_3Aq) + PO_53CaO$, to render it comparable with the foregoing we shall have $6(SO_3Aq) + 3(PO_5,3CaO)$, which may be written—

$$6(SO_3Aq) + \left\{ \begin{matrix} 2PO_5,3CaO \\ PO_5,3CaO \end{matrix} \right\} = 6CaO.$$

$$SO_3 + Aq + \left\{ \begin{matrix} 2PO_5 \\ PO_5,3CaO \end{matrix} \right\}$$

We have, thus, phosphoric acid present along with tribasic phosphate. Joulie maintains that free phosphoric acid transforms tribasic phosphate into bibasic phosphate. The author, having made many experiments with acid in different proportions and degrees of concentration, was unable to verify this fact, but found, on the contrary, that at common temperatures phosphoric acid, even in presence of an excess of tribasic phosphate, yields monocalcic phosphate. If heat is applied the case is different, the monocalcic phosphate, as fast as formed, being decomposed into free acid and bicalcic pyrophosphate. The formation of superphosphate is then composed of two stages—The liberation of two-thirds of the phosphoric acid; and, secondly, the attack of the untouched tribasic phosphate by the phosphoric acid set free in the former stage. There is no marked interval between these two stages of the reaction.

The sulphuric acid is commonly employed at 53°, that is with 4 equivalents of water, since it has to furnish not merely the water of hydration for the sulphate of lime, but that needful for the existence of monocalcic phosphate.—*Comptes Rendus.*

SOFT-SOAPS AND THEIR SOPHISTICATIONS.

By Dr. VOHL.

Soft-soaps are potash-soaps prepared with animal oils, or with the oils of seeds poor in stearic and margaric acids. The oleine obtained as a by-product in the manufacture of stearine candles is also used in their preparation. Manufacturers distinguish the oils as hot or soft, and as cold or hard. The former, which comprise the oils of linseed, sesame, and hemp, yield a soap which does not become turbid in winter from the formation of stearic and margaric compounds. Soaps made with the "hard" oils, like those of cabbage, colza, beet-root, and train, have that inconvenience, and are therefore used for summer consumption. Oleine is, from the same reason, used for summer soaps. The method in which these soaps are prepared indicates that their composition is different from that of soda-soaps. In the latter the glycerin is removed, whilst potash-soaps, if prepared directly with animal or vegetable oils, invariably contain glycerin. The soft soaps made with oleine are, of course, free from glyceri Glycerin communicates to soaps certain [illegible] wh are wanting where it is absent. It re [illegible] and less rich in fatty matter, which [illegible] of woollen manufacturers that soaps prepared directly from oils are less adapted for "milling" cloth than the oleine soaps. Attempts have been made to replace the fatty acids with resin, and the potash with soda. Experience shows that an addition of 10 per cent of resin to the oil before saponification, or 4 per cent in the finished soap, does not injure the quality and the effects of the soap. If the amount reaches 15 per cent (on the oil) it must be regarded as an adulteration. Soaps adulterated with soluble glass and starch contain 25 per cent of resin. The substitution of soda for potash must be kept within narrow limits. Soft soaps containing soda in the proportion of 1·5 to 2 per 100 parts of potash are not in the least deteriorated. The chief adulterations are practised in order to increase the weight of the soap, and enable it to take up and retain an excessive proportion of water. The substances chiefly used are silicate of soda, farina, and infusorial earth. Some manufacturers employ all these substances simultaneously. In this manner 100 parts of oil are made to yield 370, and even 400 of soap. These impurities attack the fibre of tissues both mechanically and chemically, and often destroy colours entirely. Silks and pure wools are most injuriously affected; linen, and mixtures of hemp and wool less so. It was found experimentally that cottons, after washing with these soaps, contained a considerable quantity of silica, which was not previously present. Lint made from linen which has been washed with silicated soaps is unfit for surgical uses, as it irritates all wounds, &c., to which it is applied. The value of a soft soap depends exclusively on its richness in oleate of potash. Hence, in analysing an unadulterated soap it is merely requisite to determine the fatty acid, and the potash, and to calculate the difference as water and glycerin. In the examination of a soap it is therefore necessary to ascertain, by a preliminary qualitative analysis, whether the sample is adulterated or not. The soap is dissolved in hot distilled water. If it dissolves without residue it is a good sign, as clay, infusorial earth, and all other insoluble substances are thus excluded. A small amount of blue, black, or greenish matter deposited after long standing is the result, not of intentional adulteration, but of the colouring matters added. The clear liquid is then mixed with dilute hydrochloric acid until it has a strongly acid reaction. Observe if the neutralisation is accompanied with effervescence, and if the gases given off smell of sulphuretted hydrogen. The mixture of soda-lye and of hydrochloric acid is best made in a glass funnel with a ground-glass tap fitted into its neck. Light petroleum oil (canadol) is then added, and the whole is briskly stirred up. When the canadol, which holds in solution the fatty acids and a part of the resin, is separated the tap is opened, and the acid aqueous liquid allowed to flow out. A part of this acid liquid is diluted with water in a test-tube, and mixed with iodised water, or a weak solution of iodine in iodide of potassium. If a blue colouration is produced the soap contains farina. The rest of the liquid is carefully evaporated to dryness in the water-bath; the residue is moistened with strong hydrochloric acid, the excess of which is driven off by a gentle heat in the water-bath. The residue is then washed upon a filter, and completely exhausted with distilled water. It is then dried and ignited in a platinum capsule. If a slight white residue remains silica was present in the soap. In other words, it has been falsified either with soluble glass or with infusorial earth. To distinguish these two substances the microscope is needed. With a magnifying power of 400 diameters the characteristic shields of the infusoria can be recognised. The silica precipitated from soluble glass is amorphous. The filtrate from the precipitate is evaporated to dryness in the water-bath; the residue is extracted with a mixture of equal parts of alcohol and ether, and the solution heated in the water-bath to expel the solvents. The residue is exhausted with water, a neutral solution of chloride of copper is added, and an excess of caustic potash. If the soap contains starch or glycerin there is formed a fine blue liquid. This is poured into a retort, and heated in the water-bath as long as a yellow or red precipitate is formed. If the liquid becomes colourless more solution of chloride of copper is added until it takes a decidedly blue colour, when it is heated anew in the water-bath till a precipitate is formed. After this a few drops of basic acetate of lead are added to remove a variety of organic matters. The mixture is filtered, and the liquid precipitated with an excess of sulphide of potassium. The precipitate is filtered off, and the filtrate, after being neutralised with hydrochloric acid, is evaporated to dryness in the water-bath. The residue is extracted with etherised alcohol. On evaporating away the solvent pure glycerin remains. If none appears no glycerin was present in the soap. The residue of the filtration extracted with etherised alcohol is calcined in a platinum capsule. The residue extracted with water is tested for soda with the antimoniate of potash. The solution of the fatty acids in canadol, mentioned above, as soon as it has become clear is poured into a tall glass cylinder with nine or ten times its volume of pure canadol. If the liquid becomes turbid resin is certainly present, which, after a time, is deposited at the bottom of the glass as a brown viscid mass.

Quantitative Determination of Water in Soft-Soaps.—A certain quantity of the soap, 6 grms., is weighed between two watch-glasses, the edges of which are ground and fit air-tight, whilst the glasses are held together with a brass clip. The lower glass, which contains the soap, is placed in an air-bath heated at first to 100° C., where it is left until the weight becomes stationary. The loss is, of course, water. In adulterated soaps a direct determination of water is necessary.

Fatty Acids.—Dissolve in hot distilled water a known weight of the soap, 10 to 12 grms. Add to the solution hydrochloric acid until the mixture has a decided acid reaction. Cool the mixture down to 20° C., and add a quantity of canadol equal in weight to the soap. Agitate it carefully, and separate the layer of canadol from the acid liquid by means of a funnel with a tap ground in its neck. The acid is repeatedly shaken up with fresh portions of canadol. The various oily extracts are poured into a beaker of known weight, and the canadol is evaporated off at a gentle heat. Lastly, the beaker is placed in a water-bath, or hot-air bath, and the fatty acid finally remaining is weighed. If it is desired to determine the resin the fatty acid is re-dissolved in canadol, and more canadol added as long as the liquid is rendered turbid. The whole is then allowed to settle. The clear portion is decanted off, and the fatty acid determined as above. The difference gives the resin.

Determination of Silica.—For the insoluble portion, 10 grms. of the soap are dissolved in hot distilled water, and the solution is filtered. The sediment which remains on the filter is washed, first with water, and then with dilute hydrochloric acid, then again with water. It is next dried and ignited in a platinum capsule. The weight of the residue, less the ash of the filter, gives the amount of insoluble silica in the soap. The soluble silica is determined in the filtrate and washings from the last operation. The whole is supersaturated with hydrochloric acid, and evaporated to dryness in the water-bath. The residue is moistened with concentrated hydrochloric acid, and heated anew on the water-bath to drive off excess of acid, exhausted with distilled water, and thrown upon a filter. What remains on the filter is carefully washed, dried, and ignited in a platinum capsule. The weight after ignition, less the ash of the filter, gives the amount of silica which has been present in the soluble state.

Determination of Alkalies and Acids.—For this determination we use the filtrate and washings from the soluble silica. This liquid is poured into a platinum capsule and evaporated to dryness in the water-bath, and heated till the residue is completely white. It is then dissolved in distilled water, filtered if necessary, the filtrate evaporated to dryness in a platinum capsule, ignited, and weighed. The weight of the residue gives the alkalies and alkaline chlorides contained in the soap. If sulphuric acid is present it must, of course, be previously removed in the ordinary manner. The alkaline chlorides are mixed with a saturated solution of chloride of platinum, evaporated to dryness in the water-bath, and washed with strong alcohol upon a filter, dried at 100° C., and weighed. The weight of the residue dried at 100° C. gives the alkalies of the soap. The quantity of chloride of potassium corresponding to the potash having been deducted from the total of alkaline chlorides found, the residue is chloride of sodium, from which the soda present in the soap may be calculated. The method of determining the respective amounts of alkali combined with fatty acids, or present in the caustic or carbonated state, will be given on another occasion.

Determination of Starch.—The quantitative determination of starch is difficult to perform directly, whence it is generally found indirectly along with the glycerin. If a direct determination is required, 10 grms. of the soap are dissolved in 200 to 300 c.c. of distilled water, and sulphuric acid is added until the reaction is slightly acid. The liquid is then boiled, the water evaporated being constantly replaced, until all the starch has been transformed into sugar, and no longer reacts with iodine. The liquid is then neutralised with chalk or carbonate of baryta, and filtered. The sugar is then found either by fermentation, or by Fehling's method with an alkaline solution of copper. To determine glycerin directly, a known weight of soap is dissolved in distilled water, mixed with an excess of acetate of lead, and boiled. It is then filtered, and the filtrate is treated with a current of sulphuretted hydrogen until all the lead is thrown down. The sulphide of lead is filtered off, the filtrate evaporated to a syrup in the water-bath, and the residue extracted with absolute alcohol or etherised alcohol. The alcohol is then evaporated, and the glycerin remaining behind is weighed.—*Moniteur Scientifique.*

ON SOME

RECENT PROCESSES FOR THE MANUFACTURE OF SODA.*

By C. W. VINCENT, F.C.S.

(Concluded from p. 227).

MANY of the rudimentary processes when practised with modern apparatus yield far better results than in the hands of the original inventors. As a last instance I cite the process for making salt-cake (sulphate of soda), by roasting together common salt with an excess of pyrites. This process was known as Longmaid's, and was patented by him in 1842, but had been in use on the Continent many years previously. This process being unprofitable, the next step taken in the direction was to pass sulphurous acid from the pyrites burners, together with air and steam, over common salt and oxide of iron. This was by Mr. Robb, in 1853. Four years latter Brooman took out his patent which dispenses with the oxide of iron. This process has in it the elements of success; it is at present being carried on on a large scale at the Atlas Chemical Works, Widnes, by Mr. Hargreaves. The salt, which may be crushed rock salt, is mixed with sufficient water to be moulded into bricks, and is then piled up in heated chambers, into which sulphurous acid, steam, and air are passed. Hydrochloric acid is evolved and condensed in the usual way. Mr. Hargreaves states the amount of fuel used to be one-third of that required by the sulphuric acid process, as the gases are passed into the chambers directly from the burners at a red heat, whilst the heat developed by the reaction of the sulphurous acid upon the salt also assists in maintaining the temperature. No nitrate of soda is required in the process, and thus a very costly item in the manufacture of soda is removed. The temperatures at which the materials are to be maintained do not exceed from 800° to 900° F. and are therefore not high enough to cause much destruction of the apparatus. In fact, the wear and tear is quite inappreciable.

The alkali trade still awaits the coming man, and if one may venture an opinion, it is not a new process that is required so much as improvements upon the old. The by-products of Le Blanc's process have attained such importance that they constitute distinct manufactures in themselves, and if, instead of being by-products, they had to be purposely made, their cost would be much added to. The grave defect of the Le Blanc process is the great loss of available soda. Taking the best commercial sulphate of soda to contain 97 per cent of pure sulphate, the amount obtained in the soda-ash falls very far short of that indicated by theory. According to Mactear, this loss throughout the alkali trade averages 13·75 per cent. I am informed that on the Tyne it is never less than 10 per cent, and more frequently 15 per cent; and, more than this, that makers find it at times a matter of very great difficulty to produce soda-ash of 54 per cent alkali. This serious loss of soda is due to several causes, but, as might be expected, it is in the treatment of black-ash that the greatest loss occurs. Of necessity some soda must be lost by retention in the waste, and also by careless manipulation of liqours and salts, or by imperfect lixiviation; but all losses through these causes fall far short in well-conducted works of the large amount to be sought for, an average of 13·75 per cent.

Scheurer-Kestner was the first to discover the real cause of the evil. By close examination and analysis of vat waste, he was led to the conclusion that at least 5 per cent of the loss, and frequently very much more, is due to insoluble compounds formed by the soda being kept in prolonged contact with water and the sulphides of the waste. If this cause be a true one, it is manifest that the lixiviation must be greatly accelerated. Further investigation proved decisively that in addition to this a further cause of the loss is the presence of an excess of chalk in the black-ash mixing, which is converted into lime in the furnace. When water is added, the hydrate of lime reacts upon the carbonate of soda, and renders part of it insoluble. Black-ash obtained on the large scale from 100 sodium sulphate and 95 limestone, left a tank waste containing on the average 0·39 per cent sodium, whilst a product made from 100 sulphate and 112 limestone, left 1·36 per cent sodium in the waste. This average was not appreciably affected by using sometimes a mixing coal, having 18 to 20 per cent of ash, and sometimes one having 10 to 12 per cent ashes. The natural inference is that the quantity of limestone in the mixture for soda-ash ought to be reduced to the lowest point consistent with the quality of the ash.

It has become the fashion of late years to speak of the present mode of manufacturing soda as a roundabout process, but fairly looked at I must say—though I risk bringing a storm of negations upon my head from the favourers of all the so-called direct processes—that in a great measure it derives this character from the vastness of the connected processes.

To make the sulphate, sulphuric acid has to be manufactured on a gigantic scale, but the surplus acid is in itself a source of profit. The cheapest sulphur is found in pyrites containing copper. In order to save carriage it is found profitable to smelt the burnt ore to a regulus containing 10 to 12 per cent of copper, another manufacture, and another profit.

By the action of the sulphuric acid on the salt, hydrochloric acid is set free. Here is another profitable product. A small part of the acid is used to act on limestone to furnish the additional equivalent of carbonic acid required to convert carbonate into bicarbonate of soda; part is sold, but by far the larger portion is run upon binoxide of manganese, and supplies the chlorine for bleaching-powder making. Of late an additional process has been added, for Mr. Weldon has pointed out the means of recovering the manganese, so that it can be used over and over again with but a small percentage of loss.

All these varying industries proceeding together, upon premises nominally for the manufacture of soda only, give to the Le Blanc process an air of complexity with which it should not justly be credited. Indeed, the true effect of this is that so many additional profits are brought in, that the cost of soda-making proper is reduced far below what it appears to be. Not in our day do I even hope for its being as a whole replaced, however much it may be modified.

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* A Paper read before the Society of Arts, Chemical Section, April 10, 1874.

Thus far chemistry; but, though so important that these are called, *par excellence*, "chemical works," it does not stand alone. Engineering, mechanics, and physics each have a great share in the successful carrying on of the works. Every part of the great whole must be fitted with due consideration to its performing its duty at the smallest cost of time and labour. I think it was in alkali works that the waste heat of the smelting- and other furnaces was first used upon steam-boilers; of course, to furnish the steam for the vitriol-chambers and other purposes about the works. Steam-cranes and ingeniously-devised tramways, for unloading and loading the raw materials; most careful adjustment of the various houses, so that nothing has to be carried a yard out of its way; skilful adaptations of each piece of apparatus to the end it has to fill—all these, and many more such things, testify to the grand importance of technology to the alkali-maker.

Science and technology here go side by side. The chemist has sketched out a process by which certain results can be obtained. That they are obtained, and profitably obtained, is entirely due to the technical skill that has been from time to time brought to bear upon every piece of apparatus in the works, under that keen supervision of the chemist and physicist which has so thoroughly secured its conformity with natural laws.

Nothing in the universe stands by itself; all things are interdependent; and it may be taken as an axiom in the arts, also, that no process can be improved, no branch of industry advanced, no new invention become prosperous, except by aid brought to it from without.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 21st, 1874.

Dr. Odling, F.R.S., President, in the Chair.

After the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. A. Wolff, G. Chaloner, A. B. Allen, W. Thomson, and M. Lichtenstein were formally admitted Fellows of the Society. The donations to the library were then announced, and the names of Messrs. W. H. Wilson, Richard Apjohn, M.A., W. A Carter, B.A., James Kilroe, Thomas Garside, James Henry Davies, George Cristopher, Charles Benjamin Caswell, and F. Stocks were read for the first time. For the third time—Messrs. Charles Edward Bean and H. H. B. Shepherd, who were balloted for and duly elected.

The President having called on Dr. W. H. Corfield to deliver his lecture "*On the Sewage Question from a Chemical Point of View*," the lecturer commenced by saying that perhaps the title had misled some into believing that he was going to treat of the chemical methods for analysing sewage and determining the amount of its various components: he intended, however, to confine himself entirely to the consideration of the sanitarian view of the matter, as illustrated by the chemical examination of the various products.

The removal of the refuse from towns, and especially excretal matter from the neighbourhood of habitations, was one of the most important sanitary problems of the day, the general death-rate at any place being in inverse proportion to the efficiency of the means used for this purpose. He would warn them that he considered the immediate removal of excretal matters of the highest importance, since the retention of these matters near habitations for a longer or shorter period was always certain to be attended with evil consequences. All the various systems for treating sewage might be reduced to two classes:—(1) Those in which the whole of the refuse matter was removed with the foul water; (2) those where this foul water was allowed to run into the sewers, but as much of the solid matter as possible was kept back. In judging of the respective merits of these two classes in all their varieties, chemistry comes to our aid, and shows that, where midden-pits or cesspools are used, the water of the wells in the neighbourhood becomes contaminated with nitrogenous organic matter, ammoniacal salts, and chlorides, the presence of the latter in any quantity in surface waters at places not in the neighbourhood of the sea being an almost certain indicator of sewage. Of the conservancy systems, three of the most important varieties were—(1) The employment of tubs or pails with or without disinfectants and deodorisers; (2) ash closets; (3) dry-earth closets. In these the fœces were retained, and it was advocated that they would be extremely valuable as manures, especially from the latter. It was found, however, that the earth, after having been used three times in the dry-earth closets, did not contain more nitrogenous matter than a rich garden mould, viz., 0·446 per cent, and consequently its value as a manure was so small that it would only pay for carriage to a very short distance. Dr. Voelcker had estimated it to be worth about 7s. 6d. per ton. This arises from the fact that the total amount of nitrogen excreted in the fœcal matter is not more than one-fifth that in the urine, the former only containing 1·5 per cent of nitrogen. In Paris much of the excreta are collected and sent to Bondy, and there converted into a manure called "poudrette;" this costs the city annually a large sum, although the company who manufacture the manure make a profit. The system of pails or tubs, especially with the use of deodorisers, was essentially bad, as in the latter case the refuse matter might possibly be kept in houses some time, and deodorising was not the same as disinfecting.

The lecturer then passed on to the consideration of the utilisation of the sewage resulting from the removal of the whole of the excreted matters along with the foul water, stating that the amount of nitrogen in the sewage is very nearly the same in those places where water-closets are used and the whole excretal matter removed, and where the solid portion is kept back by the use of some conservancy system. The suspended matter in sewage can be removed in great part by subsidence, but the clear liquid which passes off is still sewage, and quite unfit to be sent into our streams or rivers.

Numerous processes have been proposed for the precipitation of sewage. These remove the suspended matters more or less completely, deodorise the liquid, and precipitate a portion of the phosphates; but they are ineffectual, as they only partially remove the ammonia and the organic matter which is in solution, or do not do so at all. The clear liquid, therefore, is not in a fit state to be poured into the streams; moreover the precipitate has comparatively little value as a manure.

Of the methods of employing sewage for irrigation, that of upward filtration was found to be useless; for, although the solid matters were removed, no oxidation took place, and the effluent water was consequently quite unfit to be allowed to flow into our streams. With intermittent downward filtration the case was quite different. This system was applied to the sewage of Merthyr Tydvil, a town of 50,000 inhabitants. Here the sewage was passed on to a planted filter of 20 acres, and it was found that the effluent water contained the same amount of nitrogen as it did before it passed through the soil; but it went in as ammonia, and came out as nitrates and nitrites, being completely oxidised by its passage through the soil. In the case where the sewage is simply passed over the surface of the soil, where the plant growth alone acts, and not the oxidising action of a porous soil, the effluent water is always very impure. In order to purify sewage, therefore, it must be passed through the soil, and not merely over it.

The lecturer stated that experiments had been made during two years on an irrigation farm of 121 acres, to ascertain how much of the nitrogen was retained by the plants. In this farm about 25 tons of nitrogen per annum pass in as sewage, of which 10 per cent are lost in the effluent water as nitrates and nitrites; and 40 per cent were recovered in the crops during the first year. The latter number was probably too high for the average, the second year giving much less.

Dr. Gilbert, who occupied the Chair, said the Society was much indebted to Dr. Corfield for his lecture on this most important subject, in which he had touched on all the principal points. He quite agreed with the lecturer that all the conservancy methods hitherto proposed had failed, and no precipitation process had given a manure worth carrying beyond a very small distance. As we have to use water to cleanse our dwellings so as to get rid of all refuse matter, the best way was to send it into the sea, if near enough, and, if not, to adopt the method of intermittent irrigation, with or without previous treatment. The results alluded to by the lecturer as obtained from two years' experiments on a farm of 121 acres must not be relied on as an average; on a large scale, for a period of several years, the amount assimilated would probably be found to be much smaller.

Dr. Frankland said he had very little to add to what Dr. Corfield had already stated in his very lucid treatment of the subject. He quite agreed with him as to the comparatively small value of the manures obtained by the conservancy systems, and he thought that the proportion of nitrogen in the solid and liquid excremental matter was rather under- than overstated; he should himself be inclined to say that it was six or seven times as great in the latter as in the former. One point interested him very much,—namely, that the passage of the sewage through the soil purified it to a far greater extent than the plants growing in the land. He believed that this was the most effective method of treating sewage, although at the Norwood farm, which is a stiff soil and not underdrained, the state of the effluent water was quite satisfactory even in winter.

Dr. Voelcker believed that sewage could never be made a profitable thing, and so long as that was the main thing looked to they would never arrive at a solution of the question. With regard to the utilisation of the sewage at Bondy, they profitably extracted ammonia by distillation from the liquid containing 2 per 1000, and, although the whole of the sewage was not treated in this manner, several thousand tons of sulphate of ammonia were annually produced from it. The solid was mixed with charred peat and burnt gypsum to form poudrette, but the peat actually contained more nitrogenous matter than the solid fœcal matter did. The speaker also pointed out that the employment of large quantities of liquid for experiments on sewage was likely to give rise to errors, from the want of uniformity in the composition of different portions of the liquid.

Mr. Hope remarked that he would call the attention of the meeting to the fact that, in the application of Heisch's test to the effluent water, it was found that the organisms were produced when phosphoric acid was present; he thought, therefore, that was what we should search for to ascertain the purity of the water. A farm at Crewe, of stiff clay soil, was converted into a very fair filter-bed by paring off and burning the soil to the depth of 6 inches, and then ploughing it up to the depth of 3 feet by steam. It was then laid with drains at the distance of 4 feet apart.

Dr. Gilbert said that rapidly-growing crops assimilated much of the nitrogen, but in the winter-time comparatively little was taken up. Where dry manure was applied to land on which wheat was grown for twenty-one years successively, it was found that not more than one-third was recovered in the crop, but with barley, where it was not exposed to the winter rains, one-third was got back.

The Chairman, having thanked Dr. Corfield in the name of the Society, adjourned the meeting until Thursday, June 4, for which the following communications are announced:—(1). "On Dendritic Spots," by H. Adrien. (2). "On the Acidity of Normal Urine," by J. Resch. (3). "Note on Kauri Gum," by M. M. P. Muir. (4). "On Certain Compounds of Albumen with the Acids," by G. S. Johnson. (5). "On a Simple Form of Apparatus for Estimating Urea in Urine," by Dr. W. J. Russell and Mr. S. H. West. (6). "On Ipomœic Acid," by E. Neison and J. Bayne. (7). "On the Action of Chlorine and Bromine on Iso-Dinaphthyl," by W. Smith. (8). "On Acetyl Sulphite," and (9) "On a New Formation of Toluol," both by Dr. D. Tommasi.

CORRESPONDENCE.

INDIRECT DETERMINATION OF ALUMINIUM OXIDE IN PRESENCE OF FERRIC OXIDE.

To the Editor of the Chemical News.

Sir,—In reply to T. C. K., whose letter appeared in Chemical News, vol. xxix., p. 216, I beg to state that, upon looking up Church's "Laboratory Guide" (2nd edition, p. 142), I did not find any process described wherein advantage was taken of the powerful reducing action exerted by nascent hydrogen to accelerate the solution of ignited ferric oxide in acids, which is the only "new feature" I claim for the process described in my note "On the Indirect Determination of Aluminium Oxide in Presence of Ferric Oxide" (Chemical News, vol. xxix., p. 199). Had T. C. K. read the note referred to with a little more care than he has evidently done, he would at once have noticed the difference between the process therein sketched, and that described by Professor Church in his excellent little text-book.—I am, &c.

R. W. Emerson Macivor.

Glasgow, May 26, 1874.

SALT-CAKE, OR CRUDE SULPHATE OF SODA

To the Editor of the Chemical News.

Sir,—It will be seen, on reference to my former letter on this subject (Chemical News, vol. xxix., p. 185), that I did *not* recommend any method for the estimation of HCl in salt-cake. I simply said that, to prevent the HCl being thrown down together with the undecomposed NaCl, on the addition of $AgNO_3$ the crude sulphate might first be moistened with NH_4HO and ignited. I find from experience that, if this operation is conducted properly, the loss on ignition will be simply total free acid and moisture. The undecomposed NaCl in sample not being interfered with in the least.—I am, &c.,

Wm. Simmonds.

Oldbury, near Birmingham,
May 25, 1874.

New Couple Prepared Specially for the Application of Continuous Currents in Therapeutics.—M. Morin.—The couple is somewhat similar to that of Bunsen; but the central carbon, instead of being in nitric acid, is surrounded by a chromic salt which nearly corresponds, in chemical constitution (water excepted) to the solution of Jacobi. It is dissolved by the water bathing the zinc. The advantage of the new process is shown in that, to produce a determinate effect, the apparatus with chromate reaction is reduced to about an eighth of the volume of the sulphate of copper apparatus formerly described by the author, and in which the precipitation of copper is entirely avoided.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

OTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 6, 1874.

Solar Cyclones; Conclusion of Reply to Dr. Reye, &c.—M. Faye.—The author seeks to show that his theory is applicable to tornadoes as well as to trombes; and he gives a table, constructed by Dr. Lovines, of facts concerning tornadoes in the United States. Tornadoes are simply large trombes. Like trombes they descend from the clouds in form of inverted cones, move with these clouds, pass rapidly over places which they ravage, in the heart of a calm in the lower atmosphere which is always warm and moist, the calm returning after their passage. The mechanical effects are the same, but on larger scale. They are oftener accompanied by thunder, hail, and rain. They go quite as often in groups, or, rather, in series, only the trombes are much more multiplied, and may be observed in series of six or seven. In the United States tornadoes almost all take the direction of east, and their movement of gyration is direct. The tornadoes are more nearly allied to sun-spots by their colossal dimensions, their greater duration, and similarity in direction of gyration. M. Faye further criticises a paper by M. Gautier in *Archives des Sciences*, and a passage in Mr. Lockyer's recent work on "Solar Physics."

Shocks of Earthquake in Algeria, March 28, 1874.—M. Sainte-Claire Deville.—There were two oscillations in the forenoon at an interval of eight minutes, the first and most violent lasting seven to ten seconds, and causing an inclination in the ground of about a degree. The oscillations were gentle, doing little damage to buildings.

Observations made at the Observatory of Toulouse in the Months of February and March, 1874.—M. Tisserand.—Twenty-eight series of daily observations of sun-spots were had, and drawings made. The author gives tables for two of the spots, showing the latitude and longitude, and the time of rotation.

Scientific Ascent to a Great Height on March 22, 1874.—MM. Croie-Spinelli and Sivel.—They started from La Villette at 11.33 a.m., and reached their maximum height, 7300 metres, at 1.30 p.m. The temperature (which had been +13° at the ground) was there −22°. They came to the ground again at Bar-sur-Seine at 2.12 p.m. Spectroscopic observations were made as to the two dark bands of aqueous vapour, which M. Janssen had supposed to be of terrestrial origin, while P. Secchi thought they would persist in high regions, the vapour being in the sun. The bands were both gone by the time 7000 metres was reached, M. Janssen's view being thus confirmed. The authors had also taken with them some oxygen as a counteractive to the effects of rarefaction. It proved useful, affecting the two men differently however. The effects were more marked in M. Croie-Spinelli, who is of lymphatico-nervous temperament, than in M. Sivel, a very strong man of sanguine temperament. The former, when not respiring oxygen, had at one time to sit motionless on a bag of ballast. After a dozen respirations he could rise, talk vivaciously, look attentively at the sun, and make delicate observations. The mind was accurate, and the memory excellent. The inspirations also improved his appetite and digestion, and reduced the pulse from 140 to 120. Pigeons taken up in the balloon seemed ill at ease in the high regions. The first was despatched at 5000 metres. It commenced by beating its wings, trying for a little to get back to its cage, but finding its efforts vain it descended, describing curves 200 to 300 metres diameter, and with a high velocity of about 40 to 50 metres per second. It arrived at its destination, but not for thirty hours. The second, let off at 5200 metres, returned to its cage.

Action of Electric Fluid on Gases.—Third note by M. Neyreneuf.—Are the effects on flames due to the simultaneous action of the two electricities, or does each act separately? To answer this interpose between the flame and the point a diaphragm (conducting or not) hindering the production of a gaseous current. The beating down is as energetic as before. The induction is shown to be propagated in curved lines. The negative electricity attracts the flame which the positive electricity repels. The author inquired whether these inverse effects are produced in gases at ordinary temperature. He inserted two points, connected with a Holtz machine, in the ends of a glass cylinder; also two glass tubes, one of large, one of small diameter, the former conveying ordinary gas, which gave a small flame at the exterior end of the latter. He was thus able to ascertain the existence of a vibratory movement within the cylinder, due to the concordant actions of the two points; the flame was agitated. The agitations were much greater when the electric current was in the same direction as the gaseous current, and less marked with hydrogen than with ordinary gas.

Note Accompanying the Presentation of New Astronomical Object-Glasses of Large Dimensions.—M. Secretan.—One object-glass presented was 24 centimetres diameter, its focus at 3·25 m., the price 6300 francs. He is constructing another of 21, 27, 32, and 38 centimetres diameter severally.

System of Continuous Alarum Signals to Prevent Collisions, on Railways or at Sea, in Foggy Weather.—M. de Mat.—Air is compressed in a cylindrical reservoir, from which a tubulure conveys it to three organ pipes (giving *do, mi, sol*), which can be sounded separately or together. In fog the *do* is sounded, and whenever an engine-driver hears it in an advancing train he sounds his *mi*, the other driver then sounds his *mi* if he is on the right line, then both sound *sol*.

Diffusion Between Moist and Dry Air through a Partition of Porous Earth.—M. Dufour.—Suppose two masses of air, at the same temperature, containing unequal quantities of aqueous vapour, on the opposite sides of a porous wall. An unequal diffusion occurs, and the more abundant current is from the drier to the moister air. Various modes of showing this are described. The change of pressure is not due to change of temperature, in fact the temperature varies in the opposite direction to that in which it should if this were the cause. The unequal diffusion depends essentially on the difference between the tensions of aqueous vapour on the two sides; the increase and diminution of pressure are nearly proportional to this difference. Temperature influences the result only in an indirect way, causing greater or less differences of tension. M. Dufour thinks such apparatus as he describes might be utilised for determining the tension of vapour in free air.

Measurement of the Electromotive Force of Piles in Absolute Units.—M. Crova.—The author's method is as follows:—Let h, h', h'' be the interpolar resistances; i, i', i'' the corresponding values of the intensity of the current produced by a determinate element; instead of taking h and i as variables, trace the curve whose abscissæ are the values of i, and ordinates the corresponding values of $h\,i$. We shall obtain a straight line if the element is constant, and shall have (representing by y the values of hi), $hi = y = \mathrm{A} - ri$, equation of a straight line, the ordinate of which, at origin, represents the electromotive force, and of which the angular coefficient is the resistance of the element. If we obtained by experiment n values of h corresponding to an equal number of values of i, we should have n points of the line sought, and if this is straight we can deduce from its construction the mean values of A and of r, which might be calculated by the formulæ of Ohm by means of $n-1$ couples of n consecutive observations grouped two and two. In fact, from errors of observation, the *n* points of the line obtained will deviate very little in successive parts from an average straight line, which may be drawn without hesitation if the observations have been well made, and which will give the values sought of A and of *r*. This method has the further advantage of making known the limits between which the element may be considered as constant, and giving the value of variations beyond those limits. The author gives some examples of how the method applies.

Employment of Oxygen in a Balloon.—M. Fonvielle.—The example of Mr. Glaisher has shown that one may explore the atmosphere beyond 5000 metres without having recourse to oxygen.

Injection of Ammonia into the Veins to Counteract Injuries Produced by Viper Bites.—M. Oré.

Asphyxia through Insufficiency of Oxygen.—M. Le Blanc.

Functional Irritability on the Stamens of Berberis.—M. Heckel.—The author tried the effects of chloroform on the stamens. Introducing a drop every five minutes into a little capsule under the floral peduncle (the flower being under a receiver), the stamen movements were suspended on ten drops being given. From various experiments he concludes that functional irritability may be extinguished separately, and that although subordinated to nutritive irritability (the absolute characteristic of vitality) it is nevertheless independent of it, just as chlorophyllian respiration is independent of general respiration in plants.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 4, February 20, 1874.

The Feculometer.—M. L. Bondonneau.—The author considers Bloch's feculometer a valuable instrument for the examination of farinas containing a large amount of impurities, but disputes its utility in cases where the foreign matters do not exceed 3 per cent. The most common causes of the alteration or sophistication of commercial farinas are fermentation, desiccation at too high a temperature, the presence of fragments of cellulose and of sand, and adulteration with the powdered pulp of potatoes. In the two former cases the error is trifling, and rarely reaches 1 per cent. In the two latter the difference between the real value and that shown by the feculometer may amount to 3 per cent without any indication that the sample is adulterated. The following test should, therefore, be superadded:—4 or 5 grms. of the sample are well stirred up with 100 c.c. of water, and 3 or 4 c.c. of a concentrated solution of caustic soda are added. The farina dissolves, and the foreign matters remain suspended. If the farina is pure it yields a colourless translucent matter, but if impure the colour is more or less yellow. Hydrochloric acid may then be added in large excess, when the paste becomes a thin liquid. The foreign matters subside to the bottom, and may be separated by decantation, and examined with the microscope.

On Dextrin.—M. L. Bondonneau.—The author finds that dextrin is transformed into glucose at high temperatures, in presence of an inert gas charged with moisture. The amount of glucose formed is greater the more acid the fecula employed.

Oxalurate of Ethyl, and the Cyanurate of Oxamethan.—M. E. Grimaux.—This paper is not adapted for abstraction.

Compounds of Glucinium.—M. Al. Atterberg.—A detailed account of the composition and properties of a number of glucinic salts.

Researches on Tribromacetic Acid.—M. H. Gal.—A notice of this paper has already appeared.

Reclamations respecting the Papers by M. Henrivaux on the Insolation and the Devitrification of Glass.—M. Bontemps.—The author maintains the novelty of certain observations made by Gaffield, of Boston.

Researches on Essence of Alan-gilan.—M. H. Gall.—An account of the composition and properties of the essential oil of *Anona odoratissima*.

Determination of Tannin, Gallic Acid, and Pyrogallic Acid.—M. M. Prud'homme.—Prepare a solution of methyl green in powder, 2 grms. per litre of water. The solution of tannin is 20 grms. per litre. The standard test-liquor employed is a solution of commercial chloride of lime at 8°, diluted with 10 to 15 times its bulk of water. One-fourth of a litre of water and 10 c.c. of the tannin solution are placed in a test-glass. Chloride of lime is dropped in from a burette, constantly stirring. When the liquid has become an orange-yellow a known volume of the green solution is added. The mixture becomes a dirty green, but on continuing to add the chloride of lime drop by drop a decided yellow colour is produced without a shade of green. The amount of chloride of lime corresponding to the measure of the green employed—which is determined by a previous experiment—is subtracted from the number read off on the burette, the remainder corresponds to the tannin. The same trial is made for comparison with pure tannin. Gallic acid presents nearly the same changes of colouration as tannin. Pyrogallic acid is turned immediately yellow by bleaching-liquor. To determine the value of commercial tannin we begin by finding the quantity of pure tannin necessary for precipitating as completely as possible a solution of methyl green. A set of tannin solutions are prepared, increasing each by 1 grm. They are used to precipitate equal volumes of one and the same solution of green. The lakes thus obtained are filtered, and a known volume of each filtrate is treated with chloride of lime till decolourised. We obtain thus, for chlorine, a series of decreasing numbers, as the colouring-matter which remains in the filtrates diminishes progressively. But the moment the tannin is in excess the numbers begin to increase, the variation being more rapid than that of the decreasing series. This preliminary determination having been effected, then, to make the assay of a commercial tannin, we precipitate a solution of methyl green with a quantity of tannin, less in weight than the pure tannin just determined. We filter the lake and treat a known volume of the filtrate with chloride of lime. We obtain thus a number representing the foreign organic matters, that is to say, approximately a quantity of pure tannin of equal weight. If, on the other hand, we take a quantity of tannin equal in weight with that required to precipitate the green, and find the total amount of chlorine which it requires, the difference of the two numbers represents the pure tannin contained in the sample in question. To determine the chlorine corresponding to the unprecipitated green in the filtrate, a solution of green of the same strength may be made up with the colorimeter.

Isomerism of Terebenthene and Terebene from a Physical Point of View.—M. J. Ribau.—Terebenthene and terebene, though widely differing from a chemical point of view, agree closely in their physical properties except in their rotatory power, which is considerable in terebenthene, and *nil* in terebene.

New Reagent for Peroxide of Hydrogen.—M. Schœnn.—Calcined titanic acid is dissolved in boiling sulphuric acid, and the solution poured into a large quantity of pure water. Hydrated titanic acid is thrown down, which may be easily re-dissolved in dilute sulphuric acid. This solution is coloured orange or yellow by the peroxide of hydrogen.

Moniteur Scientifique, du Dr. Quesneville, March, 1874.

The Chemical Products shown at the Vienna Exhibition.—M. E. Kopp.—This report, translated from the German, contains a list of the members of the various juries in the Chemical Department, among whom we find only one Englishman, the late Dr. Calvert. The production of sulphuric acid in Germany has risen, during the last six years, from 1,130,000 quintals (of 50 kilos.) to 1,690,000. The valuable deposits of pyrites found in Switzerland (Valais) are mentioned as gradually coming into use. Galena and zinc-blende are now used in the production of sulphuric acid, in addition to copper and iron pyrites. Hasenclever and Helbig have constructed a kiln by the aid of which 80 per cent of the sulphur contained in blende may be utilised. This kiln consists mainly of a roasting-furnace and a kind of muffle, the sole of which forms an angle of 42° with the horizon. The blend is roasted with the aid of fuel. The gases derived from the combustion pass across the roasting-furnace, sweep round the muffle, pass under the plates which form the sole of the inclined plane, and from there into the chimney. The ores slide down the muffle, which forms an angle of 33°.

Products of the Transformation of Starch.—C. O'Sullivan.—This paper, the origin of which is not stated, does not admit of useful abstraction.

Use of Soap in Textile Manufactures.—Dr. H. Vohl.—All attempts hitherto made to replace soap by alkalies, alkaline carbonates, ammonia and its compounds, have proved unsuccessful. In textile manufactures, two classes of soaps are employed—the neutral and the alkaline, the latter containing an excess of alkali—caustic, carbonated, or in both states. The neutral soaps used in the textile trades are chiefly curd-soaps, made of soda and olive oil. They are employed principally in "ungumming" and preparing silk. According to Mulder, 100 parts of raw silk contain:—

Fibroïn	53·37
Gelatin	20·66
Albumen (?)	24·43
Wax	1·39
Fatty and resinous bodies	0·10
Colouring matter	0·05
	100·00

Subsequently Cramer showed that Mulder's albumen was a nondescript nitrogenous matter, soluble in acetic acid. The pure matter of silk, fibroïn, ranges from 50 to 60 per cent. According to Staedler, a certain quantity of the mucilage (Mulder's albumen) is necessary for the silk, and, if it be entirely removed, the fibre becomes hard and brittle. Guinon and Sobrero show that raw silk may also contain mineral matters (lime, magnesia, alumina, and oxide of iron) which are injurious in ungumming and working the silk. Fibroïn forms the nucleus of the thread, whilst the other substances form an outer covering. The latter substances are all soluble in soda, potash, and alkaline oleates—soaps. Fibroïn, on the other hand, is insoluble in neutral solvents and acetic acid. Alkalies and alkaline solutions, and the strong mineral acids dissolve it with decomposition. Very dilute potash and soda lyes do not immediately dissolve fibroïn, but even the smallest quantity of a free alkali robs the silk of its lustre, and reduces it almost to a paste. The only solvent which removes the superficial coating without injuring the fibroïn is a neutral lye of soap. The nature of the fatty acid present in soaps used in the silk manufacture is unimportant, provided the alkali be thoroughly neutralised. It must, however, be remembered that different oils are capable of saturating different weights of alkali. To determine the amount of free alkali, we dissolve in a retort 20 to 25 grms. of the soap in distilled water, and add to the solution chloride of sodium, finely powdered and chemically pure, as long as a precipitate of soap is formed. The lye is then separated, and the precipitate is repeatedly washed with pure salt-water. All the liquids are then mixed, and if they show an alkaline reaction with test-paper—indicating the presence of free alkali or of an alkaline carbonate—the mixture is treated with carbonic acid, boiled, evaporated down to dryness, or to a very small volume, and the carbonic acid is determined directly in a Fresenius and Will's apparatus. If the amount of carbonic acid thus found is the same as that determined in the soap, we know that the latter contains an excess of an alkaline carbonate, the quantity of which is indicated by the carbonic acid found. If the results of the two determinations differ, and if the soap directly gives less carbonic acid than the saline solution, it contains, then, besides the carbonate, free alkali, the amount of which is shown by the difference of carbonic acid in the two cases. If the soap assayed directly yields no carbonic acid, but the saline solution does, then there is in the soap merely free alkali, the amount of which appears from the carbonic acid found. If carbonic acid is found in neither case, the soap is neutral. This method is applicable to soft-soaps, chloride of potassium being added instead of chloride of sodium. According to Calvert, a soap for ungumming silk should contain—

Fatty acids	61·9
Soda	8·1
Water	30·0
	100·0

Or in the anhydrous soap—

Fatty acid	88·438
Soda	11·562
	100·000

or 13·074 parts of soda to 100 parts of fatty acid. The quantity of soda thus indicated in a soap for silk-boiling, is too high if olive oil be employed. If cocoa-nut oil be used, 15·12 of soda are required for 100 of cocosic acid. A good dry Marseilles soap fit for silk-boiling contains, on an average, 88·469 of fatty acid and 11·531 of combined soda. According to Unger, 100 parts of cocoa-nut oil require for saponification 13·36 parts of soda. Bolley suggests the use of borax in place of soap. Silks containing lime and magnesia have to be treated with very dilute hydrochloric acid, then to be washed in soft water, and lastly boiled with soap. Silk loses, on an average, 25 per cent in boiling, but in some cases the waste may reach 38 or 40 per cent.

On Glycerin.—Fr. Nitsche.—An account of the industrial applications of this substance.

New Procedure for Rendering Beer Unalterable.—M. L. Pasteur.—This paper has been already noticed.

Manufacture and Refinery of Sugar.—M. P. Lagrange.—This long and valuable paper is not suitable for abstraction.

April, 1874.

Reduction of Ferric Chloride to Ferrous Chloride in the Quantitative Analysis of Iron Ores.—M. Ad. Kopp.—The ordinary method of reducing ferric chloride, by means of zinc alone, is tedious and requires a large quantity of zinc. The process is greatly facilitated by the addition of a little chloride of tin (stannous chloride). The method is as follows:—A few drops of a solution of the protochloride of tin are added to the ferric solution, which must be previously heated; its yellow colour then becomes paler, without disappearing entirely. A few fragments of zinc are then added, and the solution is heated in the water-bath till perfectly colourless, which may require three-quarters of an hour. It is then filtered through a filter in the bottom of which a few pieces of zinc are placed for security; the filter is washed with water which has been boiled, and the liquid is titrated with permanganate in the ordinary manner. Care must be taken not to add too much chloride of tin. With zinc alone, the reduction requires twenty-four hours.

Critical Studies on the Composition of Chloride of Lime.—E. Richlers and S. Junker.—A lengthy paper, not adapted for abstraction.

Composition for the Destruction of Bugs and their Eggs, Fleas, &c.—M. Doré.—This mixture, which has been patented in France, consists of 80 parts of bisulphide of carbon and 20 parts of essence of petroleum.

Lutecine, or Paris Metal.—MM. Le Mat, Picard, and Bloch.—

Copper	800
Nickel	160
Tin	20
Cobalt	10
Iron	5
Zinc	5
	1000

A variety of other "receipts and formulæ" are given, which are not novel.

Reimann's Farber Zeitung, No. 10, 1874.

This number contains receipts for a scarlet on wool and cotton garments, and a dark green on the same material; a chocolate on woollens; a yellow and a claret on silks.

Coloured "Easter Eggs."—Strange as it may sound, dyeing eggs at Easter is now an important business in France. Let no one, however, ridicule this custom, for it first led to the use of albumen as a mordant.

The paper on washing plushes is continued.

There are receipts for dyeing six shades of grey on cotton; for a fast reseda on wool; a medium-brown, a dark and a light blue on alpacas; and a black on Thibet cloths and stockings. We have also a receipt for a vat-blue with a red, brown, black, and white pattern on cotton goods.

The editor gives next a receipt for cleaning kid gloves with benzin, which in this country is no novelty.

Chrome Mordant.—Wiz recommends the following mixture for printing chrome colours upon calico:—Put in a stoneware pan, holding 30 litres, 3 kilos. of chromate of potash, 4·4 litres of boiling water, and 2·6 of nitric acid at 36° B. This is done in the open air. The mixture is continually stirred with a glass rod, and 0·72 litre of white glycerin at 28° B., and 4·28 litres of acetic acid at 7° B., are gradually introduced. When the chromate is quite dissolved, and the frothing is over, it is poured into a copper colour-pan, and kept at a boil for a few minutes, till it has become a fine green. It is returned to the stoneware vessel, and allowed to stand overnight. The nitrate of potash which separates out is removed, and washed with 0·8 litre of cold water, and the washings are added to the mordant. The yield is 10 litres of mordant at 30° B., consisting of a mixture of nitrate and acetate of chromic oxide. It does not become turbid on dilution, and can be thickened easily. It neither decomposes starch-paste, nor coagulates gum-water. This mixture alone yields a good *vert Havraneck*; with logwood, a black and a grey; with quercitron, an olive; with berry-liquor, an orange; with catechu, a brown; with artificial alizarin, an amaranth; and with extract of madder, a claret.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in compositions for preserving meat, vegetables, fruit, and other articles of food. William Juby Coleman, Blackheath, Kent. July 30, 1873.—No. 2585. According to this Provisional Specification, a mixture of sulphurous acid, bisulphite of lime, bisulphite of potash, bisulphite of soda, and sugar is employed.

Improvements in the manufacture of manure. John Leigh, Manchester. August 6, 1873.—No. 2638. It is proposed to manufacture manure from human exceta, that is, from urine and fæces collected in suitable vessels or receptacles, by adding thereto fine ashes produced by the combustion of coal, street-dust, and other refuse matters, and also sulphate or muriate of lime, the latter being added to fix the ammonia contained in the excrement treated, or generated during the decomposition of the said excrement. The proportion of sulphate or muriate of lime used is about 120 lbs. to each ton of the solid material used.

Improvements in preserving meat and other articles of food. James George Petrie, Tottenham Road, Southgate Road, Middlesex. August 8, 1873.—No. 2658. This Provisional Specification describes dipping the meat in a solution of the following substances:—Bisulphite of lime, bisulphite of soda, bisulphite of alumina, and sugar.

Improvements in treating putrescent or putrescible matters, such as sewage, night-soil, fish, offal, blood, and other animal matters and vegetable matters, for the manufacture of manure therefrom. Christopher Rawson, general manager to the Native Guano Company (Limited), Saint Swithin's Lane, London, William Cameron Sellar, Blackheath, Kent, John William Slater, analytical chemist, Tamworth Terrace, Middlesex, and Thomas Sipling Wilson, engineer, Cambridge Terrace, Surrey. August 8, 1873.—No. 2662. This invention consists in making manure from sewage and night-soil, and from fish, offal, blood, and other animal matters, and from vegetable matters, by forcing through the said matters sulphurous acid gas, chlorine, hydrochloric acid gas, carbonic acid gas, nitric, nitrous, or hyponitric vapours, fumes, or gases, carbolic acid vapour, and cresylic acid vapour, or any other volatile antiseptic derived from coal-tar or petroleum. This invention further consists in mixing with animal matters the sulphite and bisulphite of lime, and sulphite and bisulphite of magnesia, the sulphates of alumina, common alum, and the sulphites and chlorides of iron or of manganese, either in lieu of, or in addition to, the treatment with the aforesaid gases. Also in mixing with night-soil bisulphite of lime and bisulphite of magnesia, either in lieu of, or in addition to, the treatment with the gases hereinbefore referred to. The matters after being thus treated are dried and powdered.

Improvements in the purification of gas, and in the extraction of residual products therefrom. Augustus George Vernon Harcourt, Christ Church, Oxford, and Frederick William Fison, Ilkley, York. August 13, 1873.—No. 2685. The objects of this invention are—First, to purify illuminating gas from sulphuretted hydrogen and from ammonia by the application of a mixture of materials which may be dealt with as one substance and used to remove both these impurities without necessitating the employment of separate purifiers or the arrangement of different materials in separate layers; secondly, to dispense with washing or scrubbing; thirdly, to use the same quantity of oxide for any length of time; and, fourthly, to obtain sulphur and sulphate of ammonia economically. To purify gas from sulphuretted hydrogen we employ hydrated peroxide of iron (hereinafter termed oxide), and to purify it from ammonia we employ a solution of persulphate of iron. The invention may be applied at once to any of the kinds of oxide now used. The solution of persulphate of iron we prepare from time to time by dissolving a part of the oxide in dilute sulphuric acid. To apply this liquid to the removal of ammonia we sprinkle it over the oxide during revivification and before the oxide is replaced in the purifier. Thus the purifier is charged with a mixture of oxide and persulphate of iron, each of which acts independently. The oxide absorbs sulphuretted hydrogen, forming sulphide of iron, water, and sulphur; the last-named substance (formed also during revivification) accumulates, and, after a certain proportion has been reached, must be removed as fast as it is formed. The persulphate of iron absorbs ammonia, forming sulphate of ammonia and oxide. The sulphate of ammonia also accumulates as the process goes on, and must be kept down by the extraction of portions from time to time. The amount of oxide in use remains constant, since all that is removed for conversion into persulphate of iron is restored by the addition of the persulphate of iron thus formed to the contents of the purifier, and its reconversion into oxide by the action of ammonia. The treatment of a part of the purifying material taken out of the bulk of that exposed for revivification in order to remove and obtain from it sulphur and sulphate of ammonia and to obtain persulphate of iron, which in turn arrests ammonia and is re-converted into oxide, is the distinctive feature of our invention. The process by which this is effected consists in extracting the material, first with water, which dissolves out the sulphate of ammonia, and next with dilute sulphuric acid, which dissolves the oxide, forming a solution of persulphate of iron. The undissolved residue consists of sulphur. By evaporating the solution of sulphate of ammonia, and by washing and drying the residue of sulphur, these substances are obtained at once in a saleable form. We propose further, as a desirable, but not indispensable, addition to the processes already described, to convert the ammonia and ammoniacal salts of the liquor from the condensers into sulphate of ammonia (reuniting this portion with the rest of the ammonia formed in the retorts), by heating the liquor, by itself or mixed with lime, in a vessel through which a current of gas passes to the purifiers.

NOTES AND QUERIES.

Valuation of Salt-Cake.—(Reply to "J. O.").—If the effect of ignition of salt-cake with addition of ammonia was simply the expulsion of a quantity of H_2SO_4 equivalent to the free HCl present, it would of course be easy to deduce thereby the amount of free HCl. But the result is much more complex, there being present not only free HCl and H_2SO_4, but also NaCl, Na_2SO_4, H_2O, &c., all of which are more or less decomposed or volatilised by the ignition. Thus "J. O." will see that the method in question would not answer, even if his obvious suggestion be adopted.—Walter Tate.

TO CORRESPONDENTS.

Erratum.—Page 227, col. 2, line 15 from top, *for* "Dr. Hill" *read* "D. Hill."

A Student.—It looks like fibrous hæmatite.

BOOKS RECEIVED.

Annual Record of Science and Industry for 1873. Edited by Spencer F. Baird. New York: Harper Bros. London: Trübner and Co.

The Journal of the Iron and Steel Institute. Vol. I., 1873. E. and F. N. Spon.

Report upon the Sanitary Condition of the Districts of the Combined Sanitary Authorities of Oxfordshire; Ladyday, 1873, to Ladyday, 1874. By Gilbert W. Child. Longmans and Co.

MEETINGS FOR THE WEEK.

Monday, June 1.—Royal Geographical, 1 p.m. Anniversary.
Tuesday, 2.—Anthropological Inst., 8.
— Zoological, 8 30.
Wednesday, 3.—Microscopical, 8.
Thursday, 4.—Royal Society Club, 6.
— Chemical, 8. Huskisson Adrian, "On Dendritic Spots." James Resch, "On the Acidity of Normal Urine." J. W. Russell and S. W. West, "On a Simple Form of Apparatus for Estimating Urea in Urine." M. M. Pattison Muir, "Note on Kauri Gum." George S. Johnstone, "On Certain Compounds of Albumen with Acids." E. Neison and James Bayne, "On Ipomæic Acid." Watson Smith, "On the Action of Chlorine, Bromine, &c., on Iso-Dinaphthyl." Dr. Tommasi, "On Acetyl Sulphite." Dr. Tommasi, "On a New Product of Toluol."
Friday, 5.—Royal Institution, 8.
— Geologists' Association, 8.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 758.

ON THE VOLUMETRIC DETERMINATION OF CARBONIC ACID BY A MODIFICATION OF SCHIEBLER'S APPARATUS.

By EDWARD NICHOLSON,
Army Medical Department.

In the course of some experiments on limestones, limes, and cements, I had great need of an apparatus which would enable fairly accurate determinations of carbonic acid to be made with rapidity. I considered it useless to import a Schiebler's apparatus if the india-rubber bladder which forms part of it was essential, for even thick india-rubber tubing loses its elasticity after a few months in India, and very thin india-rubber would probably arrive in a glutinous condition. I therefore tried setting up a modified form of the apparatus with the limited stock of materials at hand, and dispensing with the india-rubber bladder. The results have been so successful that I think the simple apparatus I made might be the basis of a less complicated apparatus than that devised by Dr. Schiebler. I append a sketch showing in Fig. 1 the actual apparatus I set up, in Fig. 2 that which I would recommend for use in countries where the manufacture of apparatus is carried on.

Fig. 1.

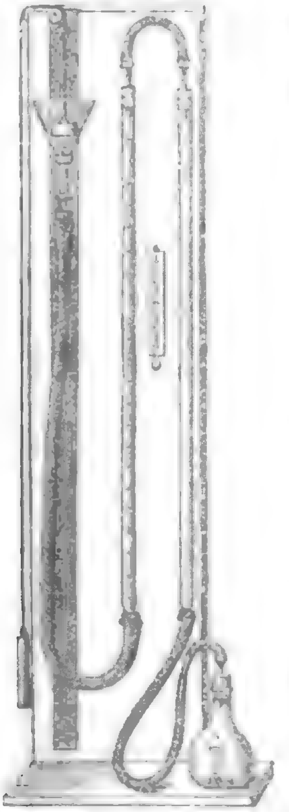
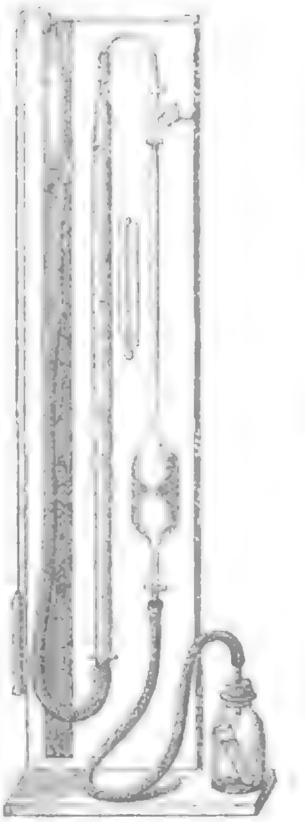


Fig. 2.



It will be seen that, for the second graduated tube of Schiebler's apparatus, with its outlet-pipe, reservoir-bottle, and blowing-tube, I substitute a reservoir which can be lowered as the pressure of gas forces down the column of water in the graduated tube. I dispense with the diaphragm formed by the india-rubber bladder, relying on the impossibility of diffusion taking place beyond the double bulb during the short time which the operation requires. If the graduated tube be of 130 c.c., a quantity of gas equivalent to 0·5 grm. of calcium carbonate will not be beyond its capacity, at least in most European laboratories. The reservoir should be able to contain, within its perfectly cylindrical part, somewhat more than the quantity of water for which the tube is graduated.

To set the apparatus in working order, raise the reservoir (by means of the cord and counterpoise) until its lower end is ½ inch or 1 inch below the zero of the graduated tube, and then pour in distilled water until the column rises to that point. Note the lower level of the water in the reservoir, consequent on the smaller calibre of the graduated tube; this difference for capillarity should be maintained at all readings of the column of water. When the column is under pressure, as at the end of an operation; the difference can, if necessary, be accurately adjusted by means of a scale corresponding to that of the graduated tube, and marked on the frame, or by a sliding pointer; but this is really unnecessary, for the allowance can be made with sufficient accuracy by the eye. Considering that the height of the column is only affected by less than one-tenth of the amount of error in the adjustment of the reservoir-level, the possible error in an adjustment by the eye is trivial. An error of a whole centimetre of height in the adjustment would affect the reading to the extent of 0·06 c.c. only. Even with a reservoir of varying calibre, as in the case of the funnel used in the rather rude apparatus I set up, the greatest possible error arising from defective adjustment for capillarity is well within 0·1 c.c.

Mode of Operating.—Into the flask or bottle used for the reaction, a weighed quantity of powdered carbonate is introduced, together with a glass or gutta-percha tube containing either 5 c.c. or 10 c.c. of diluted hydrochloric acid. The flask being connected with the apparatus, adjust the level of the water to zero, and then close the air-cock at the top of the bulb-tube. Holding the flask by the neck with the right hand, allow the acid to flow on to the carbonate, while the left hand, on the cord of the counterpoise, lowers the reservoir as the gas forces the water down in the graduated tube. Agitate the flask as the action slackens, and when the column remains fixed, read off the height, the level of the reservoir being adjusted for capillarity. The operation being finished, disconnect the flask; raise the reservoir in order to drive carbonic dioxide out of the apparatus, and then open the air-cock; it may be left open until the next operation. In the apparatus shown in Fig. 1, there is no air-cock, and the level of the water-column being depressed by the act of closing the flask cannot be brought to zero; I therefore lower the reservoir to the proper level, read off the height of the column, and deduct the number from that found after the operation.

The sources of possible error in determination by this apparatus are—

1. From expansion of the gas disengaged, in consequence of the heat produced during reaction.
2. From the absorption, or rather retention, of gas by the acid used for decomposition of the carbonate.

The first appears to be quite unimportant, except when the substance operated on contains much free base, as in the case of a partially carbonated lime; when operating on such a substance, the flask should be immersed in *air-warm* water during the reaction. The second error can be ascertained and allowed for. Dr. Schiebler sets it down at 0·8 c.c. for 10 c.c. of acid, sp. gr. 1·12. I think it better for each operator to ascertain the error for the acid he uses; let him make two sets of experiments with the same quantities of calcium carbonate, decomposing this in one set by 5 c.c., in the other by 10 c.c., of acid. I find that 1 c.c. for 5 c.c. of dilute acid (diluted with its bulk of water) is a good allowance; it is, if anything, slightly under the mark.

The volume of gas obtained being corrected for absorption, the result may be calculated in two ways, as when the original apparatus is used—Either the experiment may be succeeded by a standard experiment on the same quantity of pure calcium carbonate (in this case there is no correction excepting that for absorption, and a simple proportion gives the percentage), or the regular calculation may be applied.

For the latter calculation, special tables are of little use. In my laboratory (Bangalore), 3000 feet above sea-level, they would require to be very extensive to be of any service. The calculation can, however, be done with perfect accuracy in a very few minutes by the aid of logarithms; a set of three experiments for a mean can be entirely carried out and calculated in less than half an hour. The following is the rule:—

Corr. for Pressure. Corr. for Temp. Conversion into Weight.

$$\frac{V^1 \times (B-T)}{760} \times 1+\delta t \times 4{\cdot}468 = CaCO_3 \text{ in milligrms.}$$

V^1 is volume corrected for absorption; B, barometric pressure; T, tension of watery vapour; $\delta = 0{\cdot}0037$, coefficient of expansion of CO_2 (mean of 0·00371, Regnault, and 0·00369, Magnus); t, temperature; 4·468 is the short factor of $\frac{196{\cdot}6}{44}$.

Example I.—Barometer, 690 m.m.; temperature, 21·5° (therefore tension of watery vapour, 19 m.m.). 0·2000 grm. of marble, containing 0·3 per cent of impurity, gave, in three experiments, 53·6, 53·4, 53·8 c.c.; mean, 53·6 c.c.; corrected for absorption, 54·6 c.c.

Log. 54·6	1·7371926	
− Log. 760	2·8808136	Constant.
	$\bar{2}$·8563790	
+ Log. 671(690 − 19)	2·8267225	
	1·6831015	
− Log. 1·07955(1 + 0·0037 × 21·5)	0·0332226	
	1·6498789	
+ Log. 4·468	0·6501131	Constant.
	2·2999920 = 199·52 m.grs.,	
(− Log. of quantity taken, for percentage)	or 99·76 %	

If CO_2 be required, either the result may be multiplied by 0·44, or log. 1·966 may be substituted for that of the short factor 4·468.

Example II.—0·2500 grm. of hydraulic limestone gave, in three experiments, 45·8, 46·2, 45·7 c.c.; mean, 45·9; corrected, 46·9 c.c.

1st Method (by Standard).—The same quantity of marble (allowance being made for impurity, 0·2507 grm. was taken) gave 67·1 c.c. of gas; corrected for absorption, 68·1 c.c.

$$\frac{46{\cdot}9}{68{\cdot}1} = 0{\cdot}6887, \text{ or } 68{\cdot}87 \text{ per cent of calcium carbonate.}$$

2nd Method (by Calculation).—Barometer, 690; temperature, 22°.

Log. 46·9 − log. 760 + log. 670·4 − log. 1·0814 + log. 4·468 = = log. 170·93(− log. 0·2500) = 68·372 per cent.

The limestone gave on analysis—

Moisture	1·10
Sand and clay	29·00
Magnesium = $MgCO_3$ ..	0·70
Calcium = $CaCO_3$ ..	68·45
	99·25

I have used this apparatus for some time with steadily good results. One great advantage of it is that it cannot get out of order, except by the rotting of the india-rubber tubes in warm climates; and that, if left unused indefinitely, it always remains ready, enabling a determination of carbonic acid to be done at any moment in the space of ten minutes.

New Appointment.—Mr. William Morgan, Ph.D., F.C.S., has, we understand, been appointed Public Analyst for the Borough of Swansea.

ON THE APPLICATION OF THE POTASSIUM PERMANGANATE PROCESS FOR THE VOLUMETRIC DETERMINATION OF IRON TO THE ANALYSIS OF HEMATITE IRON ORES.

By R. W. EMERSON MACIVOR.

As Löwenthal and Lessing have shown that a hydrochloric acid solution of a ferrous salt cannot be titrated by a normal solution of potassium permanganate, and as native ferric hydrate is not dissolved to any great extent by sulphuric acid, the author has devised the following process with a view of allowing of the application of Marguerite's method to the estimation of iron contained in hematite iron ores:—

A weighed portion of the finely-powdered ore is introduced into a long-necked flask, and treated with dilute sulphuric acid. The flask and its contents are then heated to a temperature of about 100° C., and a quantity of metallic zinc (free from iron) added to the hot liquid, and the heating continued for a few minutes, when the whole of the ferric hydrate will have passed into solution, having been converted into ferrous sulphate. The strongly acid solution is then diluted with water, and filtered from the insoluble (silica, &c.), which is then well washed. Any ferrous sulphate which may have become oxidised during the process of filtration must be reduced by the addition of zinc, and boiling the liquid until no ferric salts are present. The liquid, after having been allowed to cool, is titrated in the usual way with the permanganate solution.

The results obtainable by the above process are highly satisfactory.

67, Park Road, Glasgow,
April 30, 1874.

FAVRE AND VALSON ON CRYSTALLINE DISSOCIATION.*

Of what nature is the phenomenon of solution of a solid substance in a liquid? This is the question which MM. Favre and Valson have endeavoured to answer in a series of researches communicated successively to the Paris Academy during the past two years.

Starting from a certain analogy between the phenomenon of solution and the well-known fact of condensation of a gas by a solid, the authors imagine that, in a saline solution, the aqueous molecules are condensed about the saline molecule, as, in a piece of charcoal impregnated with carbonic acid, the carbonic acid gas is condensed about the molecule of carbon. That there is, indeed, a coercitive action of the salt on the solvent appears to be indicated by the new properties of the liquid after solution of the salt; and, in particular, by retardation of the boiling-point, lowering of the point of congelation, and diminution of tension of the vapour emitted by the liquid.

"*En resume*, when a salt is dissolved in water, each molecule tends to place itself in equilibrium with the neighbouring molecules of water, the water exerting a dissociating action on the salt, and the salt, on its part, exerting a coercitive action on the water." To these two actions correspond two contrary thermal effects, the difference of which only is indicated by the calorimeter when we seek to estimate numerically the calorific phenomenon accompanying solution.

Such is the new, and certainly plausible, point of view adopted by the authors. It is no doubt a hypothesis, and a bold one, to attribute to the water, and, in general, to whatever menstruum is employed, the whole contraction observed in the solution; but as the authors, while following the guiding of hypothesis, have not omitted to consult nature, the results obtained are not the less valuable for science, which may gladly record them, without becoming bound by the theoretical ideas with which they are associated. Without insisting, therefore, on those ideas, without following the authors in a not very happy calculation of the heat liberated by coercition of the water during solution, we proceed to expound some of the results of this long series of researches—results on which the reader may put his own interpretation.

---

* M. Violle, in *Journal de Physique*.

I. *Law of Modules—Thermo-Neutrality.*—If a large number of saline solutions are compared together, the thermal effect due to each of the saline radicals is always the same, independent of the second radical with which it is associated, and defined by a constant quantity, termed its *thermal module.* To this law, established by experiments that are now old, is referred the principle of the *thermo-neutrality* of salts; in virtue of which different salts, put successively in the same quantity of water, behave, from the thermal point of view (provided they do not give a solid precipitate), in the same way as if they were dissolved separately, the various saline radicals being in complete indifference to each other, so that one cannot say that one of the metalloidic radicals is associated with one of the metallic radicals rather than with another.

Formulated in 1840, by Hess, in terms almost the same, and verified by Graham, the principle of thermo-neutrality has received from the calorimetric studies of M. Favre a full confirmation, wherever the salts operated with have been salts with a strong acid.

Among the numerous experiments made by M. Favre on this subject, I will cite only the following, in which have been measured the quantities of heat liberated by the solution of 1 equivalent of a salt in a large quantity (230 equivalents) of pure water, or in the same quantity of water containing already 1 equivalent of another salt in solution:—

Sulphate of potassium	3357
,, ammonium	3279
,, copper	3329
,, ammonium and of copper	3377
,, potassium and of copper ..	3432
,, sodium	3370
,, zinc	3324

Experiments based on quite another principle lead to the same conclusions. M. Favre has observed, in fact, that equal quantities of heat were liberated by the precipitation of 1 equivalent of sulphate of baryta, when chloride of barium dissolved was made to react on different neutral sulphates, simple or double, in extended solution. The results are contained in the following table:—

Salts Experimented on.	Quantity of Heat Liberated by Solution of the Salt.		Observations.
	In Pure Water.	In Water containing already in Solution the Equivalent of a Foreign Salt.	
Sulphate of sodium ..	−9335	−9454	The foreign salt, already in solution, was chloride of copper.
,, ammonium	−1009	−1018	
,, zinc	−2002	−1956	
,, sodium ..	−9335	−9213	The foreign salt, acetate of zinc.
,, zinc	−2002	−1970	
Chloride of potassium	−4574	−4390	
,, copper ..	−2194	−2411*	
Nitrate of potassium	−8185	−8013	
Chloride of copper ..	−2194	−2187	The foreign salt, nitrate of potassium.
Acetate of zinc	−1647	−1530	The foreign salt, sulphate of ammonium.

The thermo-neutrality of these solutions is a necessary inference.

II. *Densi-Neutrality.*—In studying the variations of volume which accompany the phenomenon of solution, M. Valson has observed that the densities of saline solutions satisfy relations of the same kind as the quantities of heat called into play. Suppose a series of normal saline solutions; that is, containing 1 equivalent (in grammes) of anhydrous salt dissolved in 1 litre of water. If we pass from one saline solution to another, different from the first only by the metallic radical, experiment shows that there is a variation of density proper to the new metallic radical; which variation is constant, and independent of the common metalloidic radical. Similarly, if we pass from a given solution to another solution differing by the metalloidic radical, this difference involves a variation in the density proper to the new metalloidic radical and independent of the metallic radical. Thus there are modules of density (which are simply these variations), as there are thermal modules, the radicals always preserving, in some sort, their personality; and there is a neutrality with reference to densities as there is with reference to heat. The principle of densi-neutrality permits, moreover, of the same restrictions as the principle of thermo-neutrality, restrictions to which we shall return later.

M. Valson has even extended the relation of neutrality to still other actions; he has shown that capillary actions also satisfy the law of modules, and that consequently they are of the same order as the preceding.

III. *Special Study of Alums.*—The alums have specially attracted the attention of MM. Favre and Valson, who have studied them as types of double salts, as regards both the thermal phenomena and the phenomena of contraction, which accompany solution.

According to the principle of thermo-neutrality, a double salt, soluble, no longer exists, in a solution sufficiently extended, in the state of a double salt. This has been ascertained by the authors, in the case of alums, by the double experimental method they had already followed for verifying the principle of thermo-neutrality; they have, then, employed successively—(1) the solution of a salt in water containing already another salt dissolved; (2) the precipitation, by chloride of barium, of the acid of the double salt in extended solution.

They have thus observed the destruction of alums by water, and they have seen, added to this, the dissociation, likewise by water (and even to an advanced degree), of the sulphate of sesquioxide of iron, which entered into the composition of two of the alums experimented with.

Thus, according to the calorimetric experiments, water seems to limit itself, in the case of alums in general, to dissociate the two constituent salts; whereas, with alums of iron, it appears to dissociate also the elements of sulphate of sesquioxide of iron, even to such a point that, according to the experiments of precipitation by chloride of barium, the sesquioxide remains in solution in presence of an acid which has ceased to exert upon it its ordinary chemical action. Is there not something here related to the curious modifications of sesquioxide of iron studied by Graham and M. Debray?

The study of phenomena of contraction, which accompany the solution of alums, shows that the principle of densi-neutrality is true for these salts, like the principle of thermo-neutrality.

There are, in fact, modules of density for the constituent radicals of these salts; that is to say, that each metal has a proper action on the density of the normal solution, independent of actions of the same order exerted by the other radicals present.

We may add that there are also, in the case of alums, capillary modules, which the authors have carefully determined.

The whole of these determinations prove that alums (and double salts in general) cannot subsist in presence of water, but that they are decomposed into their constituent salts. Indeed, we always find the same numbers for the density or the capillary height of solutions of alums, as for the quantity of heat called into play in solution; whether they are determined directly through the experiment of dissolving the alums, or calculated from numbers furnished by the solution of each of their constituent salts.

IV. *Exceptions to the Laws of Neutrality.*—The foregoing researches show that thermo-neutrality and densi-neutrality are correlative properties of neutral saline solutions; when there is thermo-neutrality there is also densi-neutrality, and *vice versa*.

---

* A slight precipitate is formed.

The experiments of which we have now to speak have shown that, when one of the properties disappears, the other disappears also.

M. Berthelot has some beautiful researches on salts which form an exception to the principle of thermoneutrality, and important consequences are deduced relative to the comparative action of *strong* acids and of *weak* acids. These denominations have now been considerably advanced in precision; the preference of certain acids for certain bases has been distinctly affirmed and justified. We shall not insist further on this side of the question; and, putting aside the acid salts which the researches of M. Thomsen have classed among the exceptions, we shall merely consider the phenomena of contraction presented by certain double salts, selecting, as our authors have done, salts already studied by M. Berthelot.

If we dissolve 1 equivalent of carbonate of soda in 1 litre of water containing already, in solution, 1 equivalent of sulphate of ammonium, the mixture presents an exception, with reference to thermo-neutrality, which is explained, as M. Berthelot has shown, by supposing an exchange almost complete between the acids and the bases.

The study of densities leads to the same consequences; the agreement between observation and calculation being re-established only if we take for calculation of averages, not the original salts, but salts (carbonate of ammonium and sulphate of sodium) resulting from their double decomposition. The conclusions are the same with borate of sodium and sulphate of ammonium.

In a general manner, the salts with strong acids alone satisfy the double relation of neutrality.

In citing these results, which have particularly struck us in the work of MM. Favre and Valson, our object has been, not so much to call the reader's attention to the results themselves, as to show him, by some examples, what valuable deductions may be made from these researches.

NOTICES OF BOOKS.

Fifth Annual Report of the State Board of Health of Massachusetts. January, 1874. Boston: Wright and Potter.

A substantial volume of 550 pages, abounding in matter interesting to all sanitary authorities and medical practitioners. The work comprises the "General Report" of the Board: the Financial Report; a paper on "Preventive Medicine, and the Physician of the Future;" a report on the present condition of certain rivers in Massachusetts, together with considerations touching the water supply of towns; the "Brighton Abattoir;" Report on the Health of the Farmers of Massachusetts; Cerebro-Spinal Meningitis in Massachusetts in 1873; Hospitals; Political Economy of Health; School Hygiene; the Work of Local Boards of Health; the Use of Galvanised Iron for the Storage and Conveyance of Drinking-Water; the Health of Towns.

Most of these papers are, of course, medical, rather than chemical, in their nature. We do not find any novel suggestion as to the best method of dealing with sewage, though the admission of such refuse into rivers is strongly condemned, and the deterioration of the streams and lakes from which the towns of Massachusetts derive their water supply is pointed out as a growing evil. There appears even reason to anticipate that, without active measures are adopted, Lake Cochituate, from which the Boston water-works are fed, may become polluted.

The analytical method used in determining the nitrogenous impurities in water is that of Wanklyn, Chapman, and Smith, which is justly pronounced "the best and most available means at present at our command." The oxygen held in solution in the waters has been determined with a standard solution of hydrosulphite of soda, as proposed by Schützenberger and Risler.

As regards the use of galvanised iron for water-pipes and cisterns, there appears to be decisive evidence that the zinc is attacked, and, to a small extent, dissolved. We should not, however, feel free to endorse the opinion that "the contained zinc-salts in solution do not exert any deleterious effects upon the human system."

It seems to us that the public in the United States take a lively interest in sanitary matters, and that the Reports of their Boards of Health, whether for entire States or for single cities, are more accessible and more widely circulated than are documents of a corresponding character in England.

Medical and Pharmaceutical Notes. By E. R. Squibb, M.D. Philadelphia: Sherman and Co.

This pamphlet includes papers on the Preservation of Hypodermic Solutions; on Ergot and its Preparations; on Rhubarb; on Physicians' Pocket-Cases; on Buying Alcohol and Distilled Spirits; and on a General Apparatus Stand, Upright Condenser, Pinchcock, and Burette Stand.

We very much approve of the author's proposal that alcohol should be sold exclusively by weight, and that in all transactions its strength should be expressed, not by reference to the excise "proof," but simply by the weight percentage of absolute alcohol present.

Dr. Squibb's apparatus-stand seems likely to be useful, but we could not make its construction intelligible to our readers without the use of illustrations.

Bulletin of the Bussey Institution. Cambridge (U.S.): Welch, Bigelow, and Co.

The "Bussey Institution" is a foundation in connection with Harvard University, having for its object agricultural experiments and investigations, and the "diffusion of sound agricultural principles and methods." The "Bulletin" before us is the first yearly issue of its transactions.

Professor Storer calls attention to the very low character, and relatively high price, of the superphosphates used in the State of Massachusetts, many of which contain not above 5 per cent of soluble phosphoric acid, and are sold at double their calculated agricultural value.

The Bussey Institution will, doubtless, do good service to agriculture, and we wish it a prosperous career and full appreciation.

The Gas Managers' Handbook. Consisting of Tables, Rules, and useful information for Gas Engineers, &c. By T. Newbigging. Second Edition. London: W. B. King.

This work has been filled with promiscuous matter under high pressure. The type is small, the margins narrow, and the language remarkably concise. We find here information mechanical, chemical, commercial, legal, and historical. We find formulæ for coloured fires, devices for illuminations, varnishes, cements, lacquers, arithmetical tables (some of which, as cloth measure and yard measure, have no very direct bearing on the subject in hand), prices of materials, hints on chemical nomenclature, and it is hard to say what. Even the value of manures has not been overlooked, gas liquor obtaining the post of honour, on the faith of certain results obtained by a Mr. Wilson, of Largs. Had this experiment been carried on, season after season, the consequence would soon have appeared as utter sterility. Neither ammonia, nor phosphates, nor potash, nor any one of the elements of vegetable life, can alone maintain the fertility of a plot of land under cultivation. Whatever substance, in a desultory experiment, happens to be wanting to a plot of land will, if applied as a manure, produce astonishing results; whilst on another plot, where the soil is in a different condition, it may be nearly useless.

We find another curious passage bearing upon agriculture:—"Gas-pipes laid through arable land do it no harm, but rather good, inasmuch as they help to drain the land. The joints should be carefully made, as the escape of gas is fatal to vegetable life." As the joints are rarely, if ever, absolutely air-tight, we fear that the benefit to the land must be infinitesimal.

The bulk of the information here offered is, however, accurate as far as it comes within our cognisance, and we have no doubt that gas managers will find it a very useful companion. One thought which this book suggested to us we deem it right not to suppress.[*] The gas manufacture is essentially a chemical art. The original decomposition of the coal, the purification of the gas, the separation and utilisation of the by-products are all chemical processes. Mechanical operations play a very subsidiary part. Yet the conduct of this manufacture has fallen exclusively into the hands of engineers. The work before us is written by an Associate of the Institute of Civil Engineers. It is dedicated to the President of that body.

We will venture to say that, unless chemists follow the example of all other professions, and organise themselves, the encroachments made upon them by medical practitioners, by pharmaceutists, and by engineers, will ultimately cut away the entire ground from under their feet.

Inklings of Areal Autometry; showing how Rectal, Curvilinear, and Mixed Planes may be Measured by their Constituent Parts with more Exactitude than by employing the Radii of Circles and Chords of Arcs. By William Houlston. London: Simpkin, Marshall, and Co.

A small book, with a long title and a useful object, but written, unfortunately, in a language not to be acquired on short notice. As a specimen, we quote the following:—"In a block-et-arc-amalgless a flux of 48 ams arises when composed of 48 amalgams (for 48 amalgs), along with 3 frag-quoins and a sub-germ; then 4 germs (for a semi-umbel) make it a capsule fluxed 48 ams; this, in turn, is taken from a capsule, and 4 circles of 4^{8} each fluxed 12 ams, yields the 4 circles cleared off the flux." "A semi-circlet is a combination of a semi-mitre and biperiare, or a dualgerm and fan-cap." We fear the public, on reading such passages, will be apt to exclaim, with old Mistress Quickly: "By my troth, Captain, these are very bitter words." We may congratulate ourselves, however, that the author is a mathematician, and not a chemist, as in that case his new-coined terms would have contained far more syllables than they now do letters.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—With regard to Mr. Cook's letter, which appeared on the 8th inst., allow me to offer the following remarks:—It is a well-known fact that, after combining the amount of phosphoric and carbonic acids in bones, bone-ash, &c., with lime and magnesia, a certain proportion of lime remains over, which, according to Professor Heintz, is assumed to occur as calcic fluoride, and to amount in recent bones to about 3½ per cent.

In a pamphlet published in 1861, Dr. Voelcker showed that recent bones do not contain so large a proportion of calcic fluoride. With reference to the excess of lime, which he invariably found in his analyses of absolutely pure bones, as well as in commercial bone-ash and animal charcoal, he writes as follows:—"As lime and phosphoric acid unite together in so many different proportions, and unite together in so many different proportions, and as many of these compounds are basic in their character, it is highly probable that bone-ash contains a more basic phosphate of lime than has hitherto been supposed to exist." At all events, it is a well-established fact that bones, bone-ash, and animal charcoal contain a considerable quantity of lime, which is neither combined as tribasic phosphate, carbonate, nor fluoride of calcium.

The cause of this excess of lime has been enquired into lately in Germany, and interesting papers by F. Wibel and C. Aeby appeared in Nos. 4 and 7 of this year's *Berichte der Deutschen Chemischen Gesellschaft zu Berlin.* These gentlemen, though differing in their conclusions as regards the pre-existence of the more basic phosphate of lime in recent bones, both agree that such a basic phosphate exists in bone-ash and animal charcoal.

In 1861, Dr. Voelcker showed that the excess of lime in bone-ash does not occur as caustic lime, and cannot be converted into carbonate by treatment with ammonic carbonate. Wibel has also made the same observation, and proved the interesting fact that, upon heating tricalcic phosphate and calcic carbonate together, a certain amount of lime of the latter enters into combination with the phosphate, and is not re-converted into carbonate by treatment with ammonic carbonate. From 30 to 40 per cent of the total carbonic acid in the original substance becomes thus lost.

I trust these remarks will meet Mr. Cook's difficulty.—I am, &c.,

Fredk. Jas. Lloyd.

16, Barbara Street, Barnsbury, N.

THE EVIDENCE OF EXPERTS.

To the Editor of the Chemical News.

The letter of "Accuracy," in Chemical News, vol. xxix., p. 215, has led me to cite the following, which came under my own observation a few months ago:—

A person, calling himself a "professor of chemistry," and practising as consulting and analytical chemist in a manufacturing town in England, is engaged by the plaintiff in a trial by arbitration, where the verdict rests principally on chemical evidence. The following are two out of many equally correct statements made by this chemist at one of the sittings of the case. The statements were made distinctly by the chemist, and written down by the arbitrator as follows:—

First.—"(That iron pyrites is a sulphide of iron having more sulphur than a protosulphide), and that, when burned for the production of sulphuric acid, the excess of sulphur burns away and leaves protosulphide of iron." Here he was questioned as to whether it was not principally oxide of iron which was left, but, as an acknowledgment of this would have quashed a theory he previously advanced, he positively denied it.

Second.—He said "that vat waste, as generally produced, contained no trace of matters soluble in water, that it was entirely composed of sulphide of calcium, and that it was incapable of oxidation."

It would be well if the system of trafficking in chemical evidence could be abolished, and that "professors" of the above stamp should find that something stronger than their moral principles would compel them in any legal case to give their unbiassed opinions or none at all.—I am, &c.,

Justice.

May 28, 1874.

SODA AND SEWAGE.

To the Editor of the Chemical News.

Sir,—I have read with much interest Mr. Vincent's paper on the manufacture of soda. I want to point out how, i my opinion, an additional profit may be yet incorporate with Le Blanc's process, and another by-product made available. I have patented a process for the treatment of aluminous schist with sulphurous acid gas, air, and steam, and, by subsequent lixiviation, the production of a liquor containing the sulphates of aluminium, iron, and magnesium. Under another patent, I treat the liquor thus produced with chloride of sodium, and, by crystallisation, separate the sulphate of sodium formed. By using the proper proportion of sodium chloride, a concentrated solution will remain, containing the chlorides of aluminium, iron, and magnesium. This may be used for the purpose of sewage defæcation, or, as described in my patent, it may be first treated with a proportion of the original liquor sufficient to convert the magnesium chloride into sulphate, which may be crystallised out, and the concentrated solution of aluminium and iron chlorides used for sewage purposes. These results have been worked out by me at great expense, and I believe each step in the process to be practical and feasible, and that, if the process were applied, sulphate of sodium might be produced at a reduced cost, and an exceedingly cheap sewage material put into the market as a by-product.

I solicit the publication of these particulars in your columns, as I am exceedingly anxious to ascertain the views of practical men on the subject.—I am, &c.,

SIDNEY W. RICH.

CHEMICAL VACANCIES.

To the Editor of the Chemical News.

SIR,—Subscribers to the CHEMICAL NEWS must often have noticed in the advertisement page the large number of advertisements for situations in proportion to the number of chemists wanted. I do not know how others fare, but twice I have advertised for a situation, and on neither occasions got an answer. Is the supply of chemists in excess of the demand for them, or is there any other reason for the disproportion? Chemists, too, as a rule, do not advertise for situations on the principle that when a chemist is wanted he is advertised for.—I am, &c.,

A. Z.

May 25, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

OTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 6, 1874.

Experimental Researches on Bihydrated Sulphuric Acid.—Is. Pierre and Ed. Puchot.—If in a bath at 5° to 6° below 0° we place a flask fitted with a thermometer, and containing bihydrated sulphuric acid, it takes the temperature 7·5°, and deposits crystals more and more abundant. As long as the whole of the liquid is not solidified the temperature of the interior remains stationary, whilst the external temperature of the bath gradually rises. The temperature of the acid, $SO_3,2HO$, remains for a long time at the same point, whilst that of the external liquid may exceed +10°. If in a bath cooled below 0° the acid, $SO_3,2HO$, assumes and preserves so long the temperature 7·5°, it is because in solidifying it disengages a sufficient quantity of latent heat which keeps the temperature at this point. The acid, $SO_3,2HO$, is one of the bodies in which it is easiest to show the phenomena of surfusion. The authors have kept from 500 to 600 grms. at the temperature of melting ice without any trace of crystallisation. Even agitation was inoperative, but on dropping in a few ragments of the crystalline hydrate crystallisation at once et in. The crystalline form of $SO_3,2HO$ is an oblique rhomboidal prism. If sufficiently cooled common sulphuric acid diluted, but containing less than 2 equivalents of water, can be split up into the crystalline bihydrate, and into a more concentrated acid.

New Process for Determining the Alcohol in Wines.—M. Ducleaux.—If to a known volume of water larger and larger quantities of alcohol are added, the density and the superficial tension of the mixtures obtained are simultaneously diminished, and consequently there is an increase in the number of drops which they form if allowed to flow slowly from a given aperture. If this aperture has constant dimensions the number of drops corresponding to each alcoholic mixture is constant also. The difference between the numbers thus found is large enough to furnish a basis for a very sensitive alcoholometric method. The instrument proposed is a pipette holding 5 c.c. It is filled with the alcoholic liquid under examination, and the number of drops escaping is counted. From this number the proportion of alcohol is calculated by the aid of tables which the author has drawn up. Slight traces of liquids more diffusible than alcohol, such as acetic ether, greatly increase the number of drops.

Density of Hydrogen Combined with Metals.—L. Troost and P. Hautefeuille.—The definite compounds formed by hydrogen with palladium, potassium, and sodium have many characters in common. All are obtained by the direct action of their elements. Hydrogen unites with palladium at 100°, with potassium above 200°, and with sodium at higher temperatures. The compounds formed are stable at common temperatures. Their formulæ are Pd_2H, K_2H, Na_2H. If hydrogen gas is allowed to act upon these definite compounds the absorption is very slight in the sodium compound, greater in th potassium, and considerable in the palladium. This absorption yields no new compounds, it is a mere condensation of the gas. The authors calculate the specific gravity of the condensed hydrogen at 0·629.

Experiments on Combustion in the Animal Organism.—P. Schützenberger.—The author concludes that the deoxidation of the hæmoglobin is due to combustion going on in the blood itself.

Bromised Derivatives of Pyruvic Acid.—E. Grimaux.—The author has obtained and examined the dibromopyruvic and tribromo-pyruvic acids.

Modifications Introduced into the Preparation of Reduced Iron.—M. Crolas.—The author maintains tha *pulvis ferri* prepared by his method is chemically pure, and never evolves sulphuretted hydrogen during its stay in the stomach.

Determination of Lime in Meteoric Waters.—H Marié-Davy.—The author has devised a volumetric method for the determination of lime. The solutions employed are chloride of calcium, oxalate of ammonia, and permanganate of potash. The standard lime solution is obtained by dissolving 1·786 grms. carbonate of lime in 1 litre of distilled water acidulated with pure hydrochloric acid. Each c.c. of this liquid contains 1 milligrm. of lime. The oxalic solution contains 16 429 grms. oxalate of ammonia per litre. For ordinary use this solution is diluted with twenty times its bulk of water. If the oxalate was neutra each c.c. of the diluted liquid would precipitate 0·2 milligrm. of lime, and would absorb 0·0714 milligrm. o oxygen to convert the oxalic acid into carbonic acid. The manganic solution contains 0·062 milligrm. permanganate of potash per litre. The author placed in a glass 20 c.c. of the lime liquor, and 81 c.c. of the dilute oxalic solution so as to ensure excess. On the other hand, he placed in a small flask 20 c.c. of water with 4 drops o hydrochloric acid. He heated till bubbles began to appear and then added the permanganate drop by drop till a permanent violet tint appeared. The permanganate employed was 0·60 c.c. This is the necessary correction for tint. 20 c.c. of distilled water, mixed with 1-10th of the oxalic solution and 4 drops of hydrochloric acid, [illegible] the same manner, decolourised 14·05 c.c. of the permanganate, the correction for tint having been made. Each c.c. of the oxalic solution decolourises then 7·02 c.c. of the permanganate. The mean is then 7 c.c., a number which requires verification from time to time. The precipitation of oxalate of lime being complete, the clear supernatant liquid is decanted, and 15, 20, and 30 c.c. of this liquid are successively treated as above. The volumes of the permanganate decolourised have been 0·66, 0·65, and 0·66 per c.c. of water. The 101 c.c. of the total liquid would therefore decolourise 66·66 c.c. The 81 c.c. of oxalic solution employed would have decolourised 81×7·0=567. The quantity of oxalic acid withdrawn by the 20 milligrms. of lime would therefore have decolourised 500·3 c.c., whence the author concludes—(1) That each c.c. of the oxalic solution would throw down 0·28 milligrm. in place of 0·25 of lime, and would absorb 0·08 milligrm. in place of 0·0714 milligrm. of oxygen. (2) That each c.c. of the manganic solution represents 0·040 milligrm. of lime, and 0·0114 milligrm. of oxygen.

April 13, 1874.

Remarks on the Spectrum of Aqueous Vapour observed in Aërostatic Voyage by M.M. J. Croce-Spinelli and Sivel.—M. Janssen.—The author recalls some observations in India and on the Red Sea, as showing that the vapour acts on all the solar radiations, from the rays of obscure heat to the ultra violet; the electric action appearing especially in the less refrangible part, and being due, he supposes, to an effect of temperature. M. Croce-Spinelli's observations confirm him in the belief that the sun has not reached that period of cooling at which aqueous vapour begins to form in the exterior envelopes.

Note of Baron Larrey on an Unpublished Work of M. Tollet, on a System of Incombustible Military Barracks and Hospitals of Ogival Form.

Note Accompanying the Presentation of the Fourth Volume of the "Memorial de l'Artillerie de la Marine."—M. Dupuy De Lome.—This volume contains an account of experiments which show that the generally received law, that the resistance of the air to artillery projectiles is proportional to cubes of their velocities, is approximately true only for mean velocities; for low velocities the resistance increases less quickly, and for high, more quickly than the cubes. In a note on explosive substances M. Sarran has calculated, for various of these, the temperature and force of explosion, and the total work each of them is capable of furnishing. From sundry experiments the Naval authorities have been led to adopt, for guns of 14, 16, 19, and 24 centimetres, powder of the Belgian type of Wetteren, having an absolute density of 1·8, the grains (in cakes of 15 m.m. thickness) having a volume of 2½ to 4 c.c. Attention is being given to the advantage (in the case of large cannon) of large prismatic or cylindrical grains of 20 to 25 c.c., pierced with seven small cylindrical holes. [A specimen of the powder was presented.] This geometrical disposition is useful, because, as the grains consume, the diameter of the holes increased, so that the productive surface of the gas increases, or at least remains constant; while, with ordinary massive grains, this surface is at its maximum at the beginning of the deflagration, and rapidly diminishes.

Extreme Smallness of the Apparent Diameter of Fixed Stars.—M. Stephan.—In various cases, by producing certain phenomena of interference, one may augment the sensibility of ordinary optical instruments. If a telescope be directed towards a luminous point, and be crossed by a screen pierced with two small apertures, there is formed in the focal plane a system of fringes alternately dark and bright, and by a simple theory the angle is known at which the distance, l, between the first two dark fringes will appear from the optical centre of the objective. Estimated in seconds of an arc, it is represented by the relation $\frac{103{\cdot}1}{l}$ (the length of undulation being supposed equal to 0·0005 m.m., and l expressed in millimetres). If the luminous source have sensible dimensions, its different points give rise to systems of fringes which encroach on one another. If, then, its diameter is equal or superior to $\frac{103{\cdot}1}{l}$ the covering is complete, and the fringes disappear. If, on the other hand, the fringes persist, we may conclude that the diameter of the source is less than the proportion named. This is the principle M. Stephan applied. He used a lunular screen, the larger axes of the lunules being parallel, and 65 centimetres apart. Having made a large number of observations, he finds that none of the stars examined (Sirius included) had an apparent diameter which reaches 0·158″. All presented fringes. It is remarkable, too, that, with all the stars (the observer being the same) the appearance of fringes commenced at the same magnification. M. Stephan perceived it first at a magnification of 600, never under this. Thus the mutual encroachment of the system of fringes produced by the extreme waves may be neglected in comparison with the separation of the bands of each system. In other words, not only is the apparent diameter of those stars less than 0·158″, but it is a very small fraction of this number.

Temperature of the Solar Surface.—M. Vicaire.—The author argues that P. Secchi's estimate is still (though reduced to two cyphers less than formerly) far from the reality, which probably does not exceed a few thousand degrees.

Determination of the Calorific Intensity of the Solar Flux.—Extract from memoir by M. Duponchel.—Spectrum analysis has proved the similarity of composition of all stars, and probably the specific heat of the sun is equal to that of our earths and metals, the average of which is not more than 0·12. M. Martius's observations in 1864 showed that the calorific radiation emitted per square metre of the solar surface could not be less than 9,356,000 calories per minute (a number eleven times higher than that given by Pouillet). Applying these figures to Pouillet's problem, the gradual cooling of the sun, from equal and constant radiation into space, would correspond to an annual lowering, not of 1-100th of a degree, but of 140° at least in the mean temperature of its entire mass (supposing perfect conductibility). Such a result shows the necessity of explaining the calorific effects of the sun by an incessant cause of renewal of heat other than any that have been suggested hitherto. M. Duponchel requested the opening of a sealed packet put in the hands of the Secretary in December, 1873, in which he advances a theory of "circulation of calorific movement in planetary systems." He supposes a calorific and luminous flux emitted by the photosphere principally in the plane of its equator, and which he terms the *arterial flux*, and there is a corresponding *venous flux*, equal and contrary in direction, going to the poles. These two fluxes of heat, having points of departure and of arrival little different, in all the regions of space, being nearly parallel or concentric and rigorously equal, the venous flux constantly restores to the sun the heat emitted by the arterial flux. The two fluxes may be considered as the two branches of the same current or circuit of vibration of the ether, occurring in the photosphere which it traverses from the regions of the poles to those of the equator, its ascending branch being diffused, and its descending branch concentrated uniformly in all the regions of space.

Influence of a Vibrating Membrane on the Vibration of a Column of Air.—M. Gripon.—If a tuning-fork mounted in its case be vibrated, and a membrane of collodion or vegetable paper vibrating in unison with it, be placed near the opening of the case (at 4 or 8 centimetres) the intense sound from the case is greatly weakened, and, it may be, extinguished. (No such effect is observed if the membrane give a different sound from the instrument, or if a solid plate be used instead). Membrane and air both cease to vibrate. The latter will only vibrate anew if a fork of higher pitch be substituted on the case. M. Gripon describes several other experiments of a similar nature.

Experiment Demonstrating the Part Played by the Veins in Absorption.—M. Oré.—This is an improvement on Magendie's method.

Aërostatic Ascent on March 22 by MM. Croce Spinelli and Sivel.—This second note is devoted to meteorological facts. The route of the balloon is shown in a drawing. Among other things, the authors mention having passed through a mass of very light needle-shaped ice crystals at about 5000 metres. They were from 20 to 40 centimetres apart, and sparkled so as to be visible at 100 metres. The temperature, +13° at starting, fell to zero on passing through a cloud, rose again to +2° above the cloud, and progressively decreased to −22° at 7000 metres. The hair hygrometer, which marked 62° at the ground corresponding to +13°, marked only 54° at 7300 metres. Two currents were observed; the one, limited by the cloud at 1800 metres, had a velocity of 9 to 12 metres per second, and a direction between W. and W.S.W.; the higher current, much thicker, had a direction between N.W. and N.N.W., and was moving 21 or 22 metres per second. It is to be noted that on March 23, the day after the ascent, the current at the ground was N.N.W., on the 24th N., and the 25th N.N.E. The current above seems to have dominated over that below.

Observations apropos of a Note by M. Moreau on the Application of the Physometer to Studying the Function of the Swimming Bladder.—M. Harting.—The author has made many experiments with his physometer during the last two years, but mostly on fresh water fish, and he gives his conclusions (which he does not apply to all fish with bladders). The chief causes of variation of volume of the bladder are—(1) Ascent and descent in the water by action of the fins (change of pressure); (2) secretion and absorption of gases contained in the bladder; (3) respiratory movements. This influence was not seen in all the species examined. It is shown by small oscillations in the water column, each oscillation composed of a rapid and direct ascent, and of three smaller oscillations during descent. (4) The active compression of the bladder through a muscular contraction. This was rare, and the diminution caused by it very small. M. Harting concludes that the active *rôle* of the swimming bladder in descent and ascent in the water is, for the fishes examined, almost *nil*.

Apparatus Indicating Automatically the Presence of Blocks of Ice or Icebergs about Ships.—M. Michel.—A case suspended from the side of the ship encloses a bimetallic thermometer with a small rod attached to the helix, which moves right or left according as the temperature of the latter rises or falls. When the temperature falls the rod comes against a small metallic knob and thus closes a circuit, ringing a bell placed near the officer on watch.

Liebig's Annalen der Chemie und Pharmacie.

March 8, 1874.

Aldehyd Derivatives of Naphthylamin.—Dr. G. Papasogli.—The author suspended recently distilled naphthylamin in water at 50° C., into which a current of sulphurous acid was passed. The naphthylamin gradually dissolved, forming a reddish yellow liquid. On cooling, a polysulphite crystallised out in nacreous leaflets grouped together in the form of rosettes. If, however, the warm aqueous solution of sulphite of naphthylamin, containing excess of sulphurous acid, is mixed with benzaldehyd, added drop by drop with constant stirring, a precipitate is formed which re-dissolves, and on cooling dendritically arranged leaflets of an aldehyd compound make their appearance. This is naphthylamin-benzol-bisulphite, $C_{10}H_9N,SH_2O_3,C_7H_6O$.

Action of Amides upon Phenols.—Dr. J. Guareschi.—The author has studied the action of benzamid and phenol, of acetamid and phenol, of benzamid and cresol, of benzamid and salicylate of methyl, and of benzamid and salicylate of ethyl.

History of Cymol.—Dr. J. Guareschi.—An account of experiments undertaken with the oil of cumin, in which he recognises two cymols, one of which turns the plane of polarisation to the right.

On Aconic Acid.—Fr. Meilly.—A very lengthy paper, not adapted for abstraction.

Eklogite of Upper Franconia.—Dr. v. Gerichten.—A specimen from Eppenreuth, near Hof. It contains red-brown garnet, with finely developed surfaces ∞ 0·202, of a size generally exceeding 5 m.m. Omphacite is also interspersed in grass-green granules, often interrupted by radiating crystals of disthene and limpid grains of quartz. Needles of apatite and granules of iron pyrites are also observed. Magnetic pyrites is probably also present. The powder is white with a faint reddish tinge. Specific gravity = 3·40:—

Silica	57·10
Phosphoric acid	traces
Alumina	11·16
Ferric oxide	2·84
Ferrous oxide	3·22
Lime	13·80
Magnesia	6·37
Maganese protoxide	0·31
Potash	0·81
Soda	2·21
Water	0·54
	98·92

An Eklogite from Silberbach, near Conradsreuth, has a fine-grained radiating appearance from the predominance of leek-green omphacite, notwithstanding the large embedded garnets. It contains less disthene and quartz than the former. Its powder is grey, and its specific gravity = 3·42; it contains—

Silica	55·00
Phosphoric acid	traces
Alumina	13·54
Ferric oxide	2·74
Ferrous oxide	3·37
Manganese protoxide	0·20
Lime	12·09
Magnesia	10·21
Potash	0·50
Soda	2·10
Water	0·32
	100·07

A third specimen from Mark Schorgast contained disthene, carinthin, muscovite, biotite, oligoclase, quartz, hyacinth, olivin, apatite, magnetic pyrites, and ordinary iron pyrites. Its composition is—

Silica	48·81
Zirconia	traces
Phosphoric acid	
Sulphur	
Alumina	16·25
Ferric oxide	6·00
Ferrous oxide	7·48
Manganese protoxide	0·43
Lime	9·72
Magnesia	7·52
Potash	0·46
Soda	2·64
Water	0·12
	99·43

The author gives also the analyses of several other specimens, points out the chemical and geological bearing of his researches, and gives, in conclusion the biblio[illegible] of the subject.

Method for the Analysis of Crystalline Minerals.—Dr. v. Gerichten.—Particular weight must be laid on certain preliminary operations which are too often overlooked.

A. (1) Microscopic examination of a thin section. To the experienced eye examination with a good lens is often sufficient. (2) Qualitative examination of fragments from different portions of the mass. Especial attention should be paid to the rarer bases and acids, such as phosphoric acid, chlorine and fluorine, sulphuric acid, titanium, sulphide of hydrogen, chrome, zirconia, glucina, strontia, lithia, &c. (3) Separation of the constituents found mixed in the mass, either mechanically or chemically, with weak acids, fusion, and subsequent treatment with acids. (4) Pulverisation for the subsequent quantitative examination. For this purpose pieces should be selected which have a fresh appearance. In coarse grained varieties portions are taken which fairly represent the general type of the rock or mineral. The operation of pulverising is best performed in a steel mortar. The powder is then sifted through lawn, care being taken that the harder granules, *e.g.*, beryll or zircon, do not remain on the sieve. The powder is preserved in stoppered bottles perfectly air dry.

B. In the quantitative analysis the constituents generally met with are silicic and phosphoric acids, chlorine, alumina, the oxides of iron, oxide of manganese, lime, magnesia, potash, soda, and water. (1) Determination of water. (*a*). Hygroscopic moisture. The substance is dried in the exsiccator. (*b*). Determination of the water according to Ludwig's method (Tschermak's *Mineral. Mittheilungen*, 1872, (3), 188). Ignition to a white heat in a platinum tube, and weighing in a chloride of calcium apparatus. (2) Phosphoric acid. About 1 grm. of the sample is fused with carbonate of potash-soda, taken up with water, evaporated to dryness with hydrochloric acid, re-dissolved with dilute hydrochloric acid, the filtrate precipitated with molybdate of ammonia, and the phosphoric acid finally determined as pyrophosphate of magnesia. (Although phosphoric acid generally occurs as apatite, which can be decomposed by nitric acid, it is in every case preferable to proceed as above directed.) (3) Protoxide of iron. (*a*). Soluble in hydrochloric acid. Variable quantities of the specimen up to 1 grm. (according to the proportion of matter soluble in hydrochloric acid) are heated with concentrated hydrochloric acid in a sealed glass tube to 120° to 150° C. for one or two hours, and the solution titrated with permanganate. (*b*). Insoluble in hydrochloric acid. About 0·5 grm. of the substance, mixed with a few drops of hydrochloric acid, is placed in a covered platinum crucible, provided with a short entrance and exit tube of platinum, and treated with recently prepared and concentrated hydrofluoric acid in an atmosphere of carbonic acid, evaporated gradually to dryness in the same gas, and titrated with permanganate. (It may be advantageous to preserve the powdered portions destined for the determination of protoxide of iron in sealed glass tubes filled with carbonic acid.) (4) In general, in the further analysis, the portion soluble in hydrochloric acid is examined separately from the part unattacked by the same solvent. Such a method can never give much better indication than a lump analysis.* The degrees of decomposability of the silicates by acids are only approximately known, and the partial decomposition of a silicate considered as insoluble by hydrochloric acid according as the action is more or less prolonged, or the acid more or less concentrated, is quite unable to throw a light upon complicated mixtures of silicates. Even in fine-grained minerals it is worth the trouble to separate the constituent parts of the mixture by means of lens and forceps, and to analyse them apart. If the texture of the specimen is very fine and homogeneous, then—until researches have been carried out which indicate the limits of the decomposition of the various silicates in stronger or weaker acids and at different degrees of pressure—we are obliged to undertake a partial analysis of the portions respectively soluble and insoluble in hydrochloric acid. (*a*). Portion soluble in hydrochloric acid. 2 to 3 grms. of the substance are heated with hydrochloric acid to a high temperature in a sealed glass tube. In repeating an analysis the same temperature should be maintained (See Rammelsberg, "Quantitative Chemical Analysis of Minerals and Furnace Products," page 175). All the phosphoric acid of the mineral is found in the ammoniacal precipitate. In the separation of the iron and the alumina the hyposulphite of soda method can scarcely be recommended. The potash method is better, but titration with permanganate surpasses both in simplicity and accuracy. (*b*). The residue insoluble in hydrochloric acid is divided in three portions; two of these are set apart for the further determination of the silicic acid (see Rammelsberg). The third portion is decomposed with hydrofluoric acid, for the determination of the alkalies taken up in hydrochloric acid, and evaporated to dryness, dissolved in water, filtered, oxidised with nitric acid, concentrated as far as possible, mixed with carbonate and hydrate of baryta, and the separation of magnesia and the alkalies completed in the ordinary manner. In "lump analyses" it is well to determine the lime once as carbonate and again as sulphate. The determination of the alkalies is preferably executed on an especial portion.

Titaniferous Iron of Abnormal Composition.—Dr. v. Gerichten.—The material for this investigation was taken from a splendid crystal of titanic iron in the mineralogical cabinet of the University of Wurzburg. Its locality is supposed to be Norway. The only substances present are titanic acid, ferric oxide, and a small quantity of ferrous oxide. Magnesia and silica could not be detected. Its composition is—

Titanic acid	46·42
Ferric oxide	52·67
Ferrous oxide	1·07
	100·16

This specimen belongs, therefore, to none of the three classes distinguished by Rammelsberg. As regards the execution of the analysis, it may be mentioned that the mineral was dissolved in hydrochloric acid in a sealed tube. For comparison it had been previously analysed after solution by means of bisulphate of potash. The procedure was as follows:—The weighed substance was heated with concentrated hydrochloric acid to 140° to 180° C. for two to three hours in a sealed tube of good Bohemian glass. The powder, deep brown at first, became a pale yellow. The tube was opened, the contents poured into boiling water, and filtered. In the solution was merely ferric oxide, whilst the residue consisted of titanic acid, coloured yellow by a trace of iron. The residue was dried, weighed, and fused with bisulphate of potash, when the titanic acid is separated as a snow-white powder, perfectly free from iron, and may be weighed. The ferric oxide in the first solution was reduced with zinc, and titrated with permanganate. The ferrous oxide was determined in a separate portion.

Abnormal Constituents of Urine after the Consumption of Asparagus.—A. Hilger.—Succinic acid was relatively abundant, the amount of hippuric acid was increased. Benzoic acid was recognised, but no asparagin. The ammonia was increased to 6·24 grms. in 3000 c.c.

Solubility of Selenium and Tellurium in Sulphuric Acid.—A. Hilger.—It is generally stated in chemical text-books that tellurium dissolves in concentrated sulphuric acid with a purple colour, and is precipitated unchanged on the addition of water. A possible oxidation of the tellurium is not mentioned, though H. Rose states that if the solution is heated sulphurous and tellurous acid are formed. The solubility of selenium in sulphuric acid with a green colour is also mentioned, the selenium being re-deposited unchanged on the addition of water.

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* *Bausch analyse*, where an entire mineral, or an accidental mixture of several chemical compounds, is analysed in the lump.

Fischer and Gmelin speak of an accompanying oxidation. Rose's statement was confirmed by experiment. With selenium the case is similar; it is not precipitated by the addition of water to its solution, but by chloride of tin.

Quantitative Determination of Iodine in Urine.—A. Hilger.—The author recommends the use of chloride of palladium. The urine must be previously acidified with hydrochloric acid. The removal of sulphuric and phosphoric acids is not needful.

Synthesis of Phenyl-butylen.—B. Aronheim.—This paper does not admit of abstraction.

Isomeric Pyruvic Acid, "Ethylmalonic Acid."—A. Tupoleff.—The author has examined the baryta silver salts of this acid.

Ether of Mono-bromo-butyric Acid.—A. Tupoleff.—The author finds that this ether boils at 174° C., or with correction 178°.

Certain Derivatives of the Primary Butyl Alcohols.—M. Grabowsky and Alexander Saytzeff.—This paper is unsuited for abstraction.

Reduction of Succinyl Chloride.—Alexander Saytzeff.—A lengthy paper, containing much hypothetical matter.

Determination of the Position-Formulæ of the Allyl Compounds, and of Acrylic Acid.—E. Linnemann.—The author concludes that the propionic acid formed from acrylic acid is in every respect identical with the well-known normal propionic acid.

α-Bibrom-Propionic Acid.—O. Philippi and B. Tollens.—Unsuited for abstraction.

On α-Monobrom-Acrylic Acid, and Conversion of α Bibrom-Propionic Acid into the β Acid.—O. Philippi and B. Tollens.—The author concludes that "the carboxylic group is contained in the β-bibrom-propionic acid, and in its derivative acrylic acid."

On β-Monobrom-Acrylic Acid obtained from β-Bibrom-Propionic Acid.—R. Wagner and B. Tollens.

Secondary Products of the Preparation of β-Monobrom-Acrylic Acid, Acrylcolloids.—R. Wagner and B. Tollens.

Theory of Dissociation or Thermolysis.—Fr. Mohr.—The theory of dissociation may be summed up in the following propositions:—(1) Dissociation is the opposite process to chemical combination, the gaseous body resuming its molecular motion which it lost on combination as heat, and converting it into a new form of motion. (2) The amount of heat which the dissociated bodies take up is exactly equal to that which they lose on combination. (3) The temperature of separation is higher than the temperature of combination. (4) Compounds whose constituents are not volatile cannot be separated by heat.

Octylic and Caprylic Acids.—J. J. van Renesse.—The author describes caprylic acid, caprylic ether, and the caprylates of barium, calcium, and zinc, and compares the properties of these bodies with the analogous octyl compounds.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in, and apparatus for, the manufacture of sulphate of soda, chlorine, hydrochloric acid, and cements. Hartley Kenyon, of the firm of Kenyon Brothers, manufacturing chemists, and Israel Swindells, analytical chemist, both of Warrington, Lancaster. August 19, 1873.—No. 2739. The features of novelty in this invention consist in mixing salt and its equivalent of sulphur together, and burning the same in furnaces, leading the gases evolved through a dried mixture of salt and alkali-makers' waste contained in a heated chamber of special construction, by which means the sulphur is ignited, and in burning alkali-makers' waste in any suitable furnace along with air and steam, and passing the gases through the contents of the same heated chamber, after which such gases are passed through towers and scrubbers for the purposes described, the residuum being useful in the manufacture of hydraulic and other cements. The chamber or cupola is of a cylindrical form, and is surrounded by a spiral flue leading from the furnaces, by which means it is heated by the products of combustion in passing to the chimney.

Improvements in means and apparatus for the impregnation of air for supplying the lungs or other parts of the body. Pierre Villiers, M.D., College Street, Fulham, and Joseph Mayer, Great Portland Street, Middlesex. August 20, 1873.—No. 2751. The object of the invention is to supply increased quantities of oxygen or other gases or vapours to atmospheric air, and to facilitate the conducting of the impregnated air to the lungs, or it may be to wounds or other openings on the surface of the body. For this purpose the impregnating material is applied in a small chamber open at the top, but enclosed in a larger and close chamber. The air to be impregnated is forced by a hand ball inflator, or other suitable forcing means, through a tube into and through the cover of the larger chamber to near the bottom of the inner chamber, so that it may be distributed amongst the matters in that vessel to absorb gas therefrom. This impregnated air thence passes away by another tube, by which and a suitable mouth-piece it may be inhaled by a consumptive or other patient, or, by adopting other forms of outlet, the impregnated air may be forced into a wound or other opening. For the supply of oxygen, camphor of Borneo is employed, combined with either rosin from cedar or from spruce-fir, or essence of canella, or turpentine, or cachou (Japan-earth), or Italian essence, or royal essence, or American white turpentine, or Mecha's turpentine, or chios (or Greek) turpentine, or maritime spruce-fir turpentine. In the respective cases, the matters are combined in equal proportions, though they do not confine themselves thereto, and then, having well mixed the particular combination, it is subjected to a heating process for purification.

Improvements in the treatment of night-soil, sewage, and other like refuse matters, and in the production of materials capable of being employed for the purposes of deodorisation. William Henry Hughan, Morningside, Eccles, Lancaster. August 20, 1873.—No. 2760. The essential points of this invention have reference to the treatment of sewage, night-soil, and other refuse, and consist in employing materials such as peat, sand, sawdust, coal, coke, sea-weed, or other vegetable matters, and also, domestic, town, farm, or other refuse, or sweepings or ashes, in conjunction with clay, sand, portland or other cement, magnesia or magnesium limestone, salt, or mixtures of two or more of the same, in order that the resulting combination, after having been submitted to a carbonising process, shall form what is termed a cement or carbonised product.

An improved solvent, obtained by the distillation of crude turpentine. George Haseltine, LL.D., Southampton Buildings, London. (A communication from Richard Lloyd, New Orleans, Louisiana, U.S.A.). August 20, 1873.—No. 2761. The present invention consists in producing a solvent, which is a product resulting from the distillation of crude turpentine at an exceedingly low temperature, and the separation of the pyroligneous acid water therefrom while in vapour.

An improved manufacture of soap. Richard Gibbon, Warwick House, Maidstone, Kent. August 21, 1873.—No. 2766. The object of the invention is to obtain soap possessing increased cleansing properties, particularly adapted for laundry and such like uses, and this is effected by the combination with the soap, during manufacture, of the best imperial or other blue.

Improved means of, and apparatus for, condensing and rendering harmless arsenious, chlorous, sulphurous, and other unpleasant and deleterious gases or vapours that are given off in the manufacture of portland and other cements and limes, as well as in the treatment of mineral and metallic ores. Sampson Taylor Rowe, analytical chemist, Redruth, Cornwall, and Isaac Charles Johnson, cement manufacturer, London. August 21, 1873.—No. 2769. This mainly consists in fitting an intermediate downcast shaft between the upcast and the chimney, water being permitted to fall and spread to condense the vapours.

Improvements in the method of treating zinc alloys for the purpose of recovering the zinc therefrom. James Wright, civil engineer, Gresham House, Old Broad Street, London. (A communication from Mariano Guillem, Marseilles, France). August 21, 1873.—No. 2778. My invention relates to an improved method of recovering zinc which has been used for de-silvering or separating other metals, chiefly lead. To carry this out, I arrange in a furnace one or more dry crucibles or melting-pots, into which the alloy containing the zinc is placed. A tube passes from each of the crucibles, and connects it with a closed receiver; the mouth of the crucible and the pipe connections with the crucible and receiver, as well as the crucible mouth, being luted or hermetically closed, the furnace is brought into action, and, upon a white heat being obtained, the zinc volatilises, and passes through the pipe into the receiver, where it is deposited in a metallic state.

NOTES AND QUERIES.

Alumina.—Can anyone inform me whether alumina melts before the oxyhydrogen-flame into a clear transparent globule, as stated in some works, or into an opaque bead?—Al.

Bleaching Oils.—Can any of your valued correspondents kindly inform me, through the medium of the Chemical News, how to bleach a dark oil and the stearine pressed from a brown animal grease produced in tanneries.—A Young Chemist.

Cleaning Wire Blinds.—Although I have taken in your valuable publication for more than ten years past (to send to my son in India), I have never before troubled you with any correspondence, and, if you will not think it impertinent of an old lady of seventy-eight, I shall feel grateful if you will give me the following information either in your Chemical News or direct. I have some valuable *wire* window blinds, but unfortunately they have got my late dear husband's name, &c., on in gold-leaf, &c. (I presume). I am desirous to remove the letters without injuring the delicate wire, so as to be able to use the blinds for my private home. Will you be good enough to tell me how to do this; although a doctor's wife I know little of chemistry, and my son is too far away to give me immediate information.—J. S.

THE CHEMICAL NEWS.

Vol. XXIX. No. 759.

NOTE ON ANTIMONY TRI-IODIDE.

By R. W. EMERSON MACIVOR.

When an intimate mixture of finely-powdered metallic antimony with dry iodine is heated in a porcelain basin over which an inverted glass funnel is placed, orange-red vapours of antimony tri-iodide are given off, which condense within the funnel to form very fine, transparent, scarlet-coloured scales. The product thus obtained, however, always contains more or less uncombined iodine, which may be removed by mixing the impure substance with powdered antimony, and subjecting it to re-sublimation. Antimony tri-iodide may also be obtained by the action of heat on a mixture of antimonious sulphate with dried potassium iodide. It is also formed by heating antimony tribromide with potassium iodide.

Antimony tri-iodide, "$\mathrm{Sb}'''\mathrm{I}_3$, when heated to a temperature of 165·5° C., fuses to a reddish-brown coloured liquid, resembling bromine in appearance, which enters into ebullition at an elevated temperature. It is soluble in alcohol and carbon disulphide, but is insoluble in benzol. Cold concentrated hydrochloric acid does not dissolve it, but on the application of heat it is easily soluble in that menstruum. By heating with strong sulphuric acid, it is decomposed, antimonious sulphate being formed. Strong nitric acid also decomposes it when assisted by heat.

Antimony oxy-iodide, $Sb_4I_2O_5$(?), is a lemon-yellow precipitate formed by the action of hot water on the tri-iodide.

38, Gladstone Street, St. George's Road,
Glasgow.

ON THE

CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

By THOMAS ROBERTSON OGILVIE, F.C.S.,
Joint Public Analyst, Greenock.

No. II.

I will feel obliged if you will allow me to reply to some remarks by Mr. Moore in Chemical News, vol. xxix., p. 205, on a paper of mine on the above subject.

(1). Mr. Moore questions the statement that the "alcoholic extract" contains the organic principles, creatin, inosic acid, &c., because they are not soluble in cold alcohol, and nearly insoluble in hot. His objection would be valid if cold absolute alcohol had been used; but, as these bodies are taken up by aqueous alcohol, and as such was used in the analyses, it is quite unfounded. In support of this statement, I will simply say that Liebig—than whom no one should be listened to with greater respect regarding these bodies—states that true extract contains 80 per cent soluble in 85 per cent alcohol, and directs that the creatin and creatinin be searched for in the alcoholic solution. Similar assertions have been made by other authorities, and, as they remain unchallenged, I adhere to the strict accuracy of my statement.

(2). I fail to perceive the point of Mr. Moore's reference to the use of the term "fibrin or syntonin." No one, I think, who gives the slightest consideration to the matter would conclude that it refers to anything else than the insoluble portion of flesh which remains after treatment with water, and which is always known as muscle-fibrin or syntonin, in contradistinction to blood-fibrin. There is not one word in my paper to suggest that I am not cognisant of the characteristics of the different forms of fibrin; so that, while anything Mr. Moore says on that subject may be of interest in the proper place, his remarks are altogether irrelevant as criticisms on my paper. I hold that the phrase in question is quite intelligible and strictly accurate.

(3). Mr. Moore asserts: "there is no justification for the statement 'thus fat is not only indispensable in the process of repair of all cellular and fibrous matter, but is also necessary for the digestion of the other elements of food,' for herbivorous animals take but little fat in the food they eat, yet they convert starchy matter largely to fat." Well, I repeat the statement, and hold emphatically that it is essentially correct. In support of my position, I beg to cite the following authorities:—

(a). "The azotised compounds, when taken alone, are insufficient to support life; saccharine and oleaginous matters are absolutely necessary, and in the young even of carnivora they form, in the shape of milk, a most important part of their nutriment. Even the flesh diet of the carnivora contains a large proportion of fat, which supplies the necessary material of this kind."—(Miller's "Elements of Chemistry," 4th edition, Part III., pp. 192-3.)

(b). "The association of oleaginous with albuminous matter seems to be essential in every act of nutrition. We find the two combined in the yolk of the egg, in the chyle, and in the organisable *blastema* exuded for the reparation of breaches of substance."—(Carpenter's "Manual of Physiology," 4th edition, p. 322.)

(c). "It is obvious that if flesh employed as food is again to become flesh in the body, if it is to retain the power of reproducing itself in its original condition, none of the constituents of raw flesh ought to be withdrawn from it during its preparation for food. If its composition be altered in any way, if one of the constituents which belong essentially to its composition be removed, a corresponding variation must take place in the power of that piece of flesh to re-assume in the living body the original form and quantity on which its properties in the living organism depend."—(Liebig, "On the Chemistry of Food," p. 122.)

(d). "When we consider all these facts, we shall be almost involuntarily led to the conclusion that fat takes a highly important share in the most important, and at the same time the most mysterious, processes in the formation of cells and tissues. We cannot believe that fat is a mere incidental agent in all these processes, but we must rather regard it as of essential aid in the process of converting nitrogenous nutrient substances into cells and masses of fibres in like manner as it co-operates in the processes of lactic acid fermentation and digestion, and it is probable that, whenever a chemical equation representing the formation and function of certain cells can be established, fat will constitute one of the integral factors. . . . . None but those chemists who, imagining they comprehend Liebig's views, have formed and illustrated a physiology of their own, could have regarded the animal economy as a furnace, and fat as a simple and crude material for combustion."—(Lehmann's "Physiological Chemistry," vol. i., pp. 268-9.)

"We also at the same time drew special attention to the fact that no animal cell and no fibre was formed independently of the presence of fat. Indeed, the fat appears to possess the property of predisposing the animal organism to the formation of cells."—(Lehmann's "Physiological Chemistry," vol. iii., p. 211.)

If "there is no justification" for my statement, then there is as little for any of the assertions made by the eminent and credible authorities I have just quoted. Into the old controversy between Boussingault, Dumas, Milne-Edwards, Liebig, Persoz, Scherer, and others, regarding the change of starch and sugar into fat in the animal organism, I do not intend to enter. To any careful reader, it must be apparent that the statement which has been pronounced to have "no justification" had special reference to the necessity for the whole constituents of flesh being eaten together, so as to obtain their proper and full nourishing value; and if Mr. Moore can substantiate that the people in this country, who every day consume such articles of diet as butcher-meat, butter, milk, or other substances containing fatty or oleaginous matter, can subsist in good health on nitrogenous and non-nitrogenous matters which are entirely destitute of any quantity of fat, then he will show reason for the stricture he has made, but in the meantime he has produced none whatever.

(4). Mr. Moore says "it cannot matter whether fat is necessary for the repair of those tissues (cellular and fibrous), though it is well known that neither of them contain fat." I did not in the slightest way suggest that they contained fat; what I said was, that fat is indispensable in their repair, that is, indispensable as an agent in their repair.

(5). "As without them (the salts) the other bodies could not be ingested," I have to acknowledge that Mr. Moore has laid his finger on a real error here, and I am grateful to him for doing so. The word "ingested" should be "digested," as written in my manuscript, but as the article was printed from a copy by an amanuensis, I cannot say exactly how the one word was substituted for the other. One or two other clerical slips in the paper would have been corrected if the article had not been printed before the proof was returned.

(6). I have neither "fallen into a greater error," nor have I "been misinformed" in saying that creatin corresponds in chemical relationship with caffeine or theine. Does Mr. Moore mean to say that two bodies such as creatin and caffeine, which have the same component elements, form crystalline salts with certain acids, have a bitter taste, and correspond in their solubility in the same solvents, do not correspond in chemical relationship? I am aware that the products of the decomposition of each are different, but that does not render it a "greater error" to say that they resemble each other in the characteristics mentioned. I hold, therefore, that Mr. Moore's phrase "greater error" is quite uncalled for.

(7). Mr. Moore further remarks: "So far from exciting mental activity, urea and creatin produce coma, and lactic acid produces variously, if in excess, rheumatics, rickets, or mollities ossium." Let me say that any statement as to the action of these bodies *in excess* is entirely irrelevant in discussing their action when present in the normal quantities, in which they occur in flesh, or in the proportion of beef-tea or meat-extract usually taken. It would be as logical to say that, because alcohol when taken in excess is poisonous, that therefore a light wine, when used in moderation, is also poisonous. Would it be justifiable to argue that, because caffeine in quantities of from 2 to 10 grains produces palpitation of the heart, intermission of the pulse, confusion of the senses and delirium, that therefore the question whether coffee or tea, as usually taken by people of moderate taste, are beneficial, "is still an unsettled point." But, further, we can deduce but little guidance in estimating the value and influence of the juice of flesh, beef-tea, or Liebig's extract by experimenting with their constituent principles individually. For instance, it has been shown that the action of caffeine, when freed from its associated bodies, in no way explains the stimulating and reviving power of coffee. And neither does the action of the organic principles and mineral salts present in the juice of flesh, when they are experimented with separately, give any specific indication of their action on the human system, when taken as associated together in their natural condition and proportions. Although familiar with the experiments of Bogoslowsky and others when writing the paper under discussion, I purposely left them in abeyance because they are objectionable on this ground. They are interesting as experiments, but can only be viewed as suggestive or tentative for other and more exact ones.

I hold, therefore, the view of the most trustworthy inquirers on this subject, that while meat extract does not give actual strength, it gives the sensation of vigour, by a peculiar stimulating or restorative action on the nervous system; and further, that in the present state of our knowledge we are warranted in attributing that power to the "extractive bodies" referred to. If Mr. Moore means to say, by referring to Bogoslowsky's experiments, that extract of beef solution acts in exactly the same way as warm water, and that in certain doses it has a poisonous influence, I venture to say that he holds views which are in direct opposition to those of nearly the entire medical faculty, whose knowledge on this matter is based, not upon empirical laboratory experiments, but upon the direct and long-continued observation of its effects upon the human system. If he does not hold such views, then the experiments he quotes are foreign to the discussion, or he should have defined the exact interpretation he puts upon them.

If he admits that preserved mutton "is largely used in asylums, prisons, and workhouses" (and he might have quite safely added, by all classes of society outside of these buildings as well), "and the inmates of which undoubtedly preserve their health and strength in a remarkable manner," and that it is "an excellent food," then I think, irrespective of scientific evidence, he is bound to grant that meat extract is beneficial, because it also is largely used in hospitals, is an almost invariable article in the sick room, and of late has come into general use for soup-making, and in all these cases with the best results.

In conclusion, while I reciprocate the expression of good feeling with which Mr. Moore closes his letter, I cannot refrain from saying that a series of more unfounded and hypercritical strictures than it contains I do not recollect at any time to have read in the pages of your journal.

ON THE DISSOCIATION OF CERTAIN COMPOUNDS AT VERY LOW TEMPERATURES.

By A. R. LEEDS,
Prof. Chemistry, Stevens Institute of Technology.

It has been shown by Fittig[*] that ammonic chloride, when in solution in water, is decomposed by boiling. H. C. Debbits[†] has recently investigated other salts of ammonia, especially the nitrate, sulphate, oxalate, and acetate, and has found that all of these liberate ammonia, not only when their solutions are boiled, but also, in case a current of pure hydrogen is passed through their saturated solutions, at the ordinary temperatures and even at 0° C. This latter observation is a confirmation of what was stated previously by Gernez,[‡] that when an inert gas like hydrogen or nitrogen is passed through a salt in solution or in the fused condition, it causes the liberation of a certain constant quantity of that one of the constituents which is volatile at the temperature of the experiment. This is true of the hydrosulphates, the bisulphites, the biacetates and the bicarbonates, a solution of potassic bicarbonate "even at ten degrees liberating increasing quantities of carbonic acid." In like manner the nitrates may be made to set free a portion of the acid at temperatures far below those which are ordinarily regarded as their decomposing points.

The object of the present investigation is to establish:—

1st. That it is not necessary to change the atmosphere in contact with the particles of the salt held in solution, by passing a current of an inert gas, in order to induce dissociation at temperatures below the the boiling point.

2nd. That there is a certain fixed temperature, which is different in the various salts, at which the dissociated constituent can be detected and recognised by sufficiently delicate tests.

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[*] *Ann. Chem. Pharm.*, cxxviii., s. 189.

[†] *Ber. der Deutsch. Chem. Gesell.*, v., p. 820.

[‡] *Comptes Rendus*, lxiv., p. 606.

3rd. That it is highly probable that the dissociation of these salts in solution is analogous to the evaporation of the solvent, and that while it arrives at a maximum, under ordinary atmospheric pressures, at the boiling-points of their saturated solutions, yet it takes place in a diminishing proportion at much lower temperatures, in some cases even below their freezing-points.

The reagent employed in these experiments was alizarin, an alcoholic solution of which will readily detect one part of soda in three millions of water, and a correspondingly small amount of potash, ammonia, &c. The apparatus consisted of a small flask, closed by a cork through which a delicate thermometer was passed with its bulb immersed below the surface of the liquid. A short tube entering the neck of the flask at right angles contained a coil of alizarin paper, dry and carefully supported out of contact with any moisture which might condense on the sides of the tube. The results of the experiments are given in the following table, Bar. 29·84—29·82 in.

The temperature of the solutions at the beginning of the experiments was 17°—20° C., and the increase was conducted very gradually and slowly, about a half hour being required for each determination. The alkaline reaction was made evident by quick and sharp transition from yellow to red of the alizarin paper at the temperatures indicated. In the case of ammonic chloride it would at first appear that there was a progressively slow increase of the point of sensible dissociation with the dilution of the liquid, but this was probably owing to the extreme slowness with which the liberated ammonia from a very dilute solution diffused itself, rendering it difficult not to overstep the temperature actually requisite.

Liquid.	Reaction of Liquid.	Parts in 100.	Temp. deg. C.	Mean deg.	Reaction of Vapour.
Ammonic Chloride.	Feebly acid	10·60	37	37	Strongly alk.
" "	" "	"	37		" "
" "	" "	5·30	38	38·5	Alkaline. "
"	" "	"	39		" "
" "		2·65	39	39·3	" "
" "		"	40		Feebly alk. "
" "		"	39		" "
" "		1·325	39 39	39·2	" "
"		"	39 41		" "
" "		"	38 39		" "
" Sulphate.	Acid.	45·62	50	50·5	Alkaline.
" "	"	"	51		"
" "	"	22·81	51	51	"
" "	"	"	51		"
" "		11·40	50·5	50·5	Faintly alk.
" "		"	50·5		" "
Oxalate.	Strongly alk.	Saturated at 7·5° C.	−1	−1	Strongly alk.
"			−1		
Acetate.	Acid.	Saturated at 17° C.	55	55	Alkaline.
			55		"

The ammonic oxalate was surrounded by a freezing mixture, and when the mass was frozen, an alkaline reaction was obtained almost immediately on inserting the coil in the exit tube. The atmosphere surrounding the apparatus in this experiment was likewise below the freezing-point. It is probable that the point of sensible dissociation was much lower than that observed.

Finally, this point of sensible dissociation depends on the circumstances of the experiment, and the delicacy of the apparatus and reagents employed in its detection. For when a thermometer and a coil of paper supported at the distance of 3 m.m. from the surface of the liquid were placed in a sealed flask containing the ammonic chloride solution employed in the first experiments, tabulated above, it was reddened at the expiration of an hour, the temperature being 20°, and when the flask was previously exhausted of air, at 17° C. The lower temperature in the last case was probably due to the rising of air bubbles into the vacuum above the liquid. The temperatures of sensible dissociation above given are not to be regarded therefore as absolute, but as relative and valuable only as indicative of the comparative dissociability of these salts when in aqueous solution.—*American Journal of Science and Arts.*

ON THE PHYSIOLOGICAL ACTION OF LIGHT.*

By JAMES DEWAR,
Lecturer on Chemistry, University of Edinburgh,
and JOHN G. M'KENDRICK, M.D.,
Demonstrator of Practical Physiology, University of Edinburgh.

I.

The authors of this communication have more especially directed their attention to the problem of the specific effect produced on the retina and optic nerve by the action of light. Numerous hypotheses have been made from time to time by physicists and physiologists; but up to the present date our knowledge of the subject is without any experimental foundation. For example, Newton, Melloni, and Seebeck stated that the action of light on the retina consisted of a communication of mere vibrations; Young conjectured that it was a minute intermittent motion of some portion of the optic nerve; Du Bois-Reymond attributed it to an electrical effect; Draper supposed that it depended on a heating action of the choroid; and Mosier compared it to the action of light on a sensitive photographic plate.

It is evident that, in accordance with the principle of the transference of energy now universally accepted, the action of light on the retina must produce an equivalent result, which may be expressed, for example, as heat, chemical action, or electro-motive power. It is well known that the electro-motive force of a piece of muscle is diminished when it is caused to contract by its normal stimulus, the nervous energy conveyed along the nerve supplying it; and similarly a nerve suffers a diminution of its normal electro-motive force during action. In the same manner, the amount and variations of the electro-motive power of the optic nerve affected secondarily by the action of light on the retina, are physical expressions of certain changes produced in the latter; or, in other words, are functions of the external exciting energy, which in this case is light. Considerations such as these led us to form the opinion that the problem of what effect, if any, the action of light has on the electro-motive force of the retina and optic nerve, would require for its investigation very careful and refined experiment.

The inquiry divided itself into two parts,—first, to ascertain the electro-motive force of the retina and nerve; and, second, to observe whether this was altered in amount by the action of light. The electro-motive force of any living tissue can be readily determined by the method of Du Bois-Reymond. This great physiologist found that every point of the external surface of the eyeball of a large tench was positive to the artificial transverse section of the optic nerve, but negative to the longitudinal section. This he accomplished by the use of his well-known non-polarisable electrodes, formed of troughs of zinc carefully amalgamated, containing a solution of neutral sulphate of zinc, and having cushions of Swedish filter paper on which to rest the preparation. (To protect the preparation from the irritant action of the sulphate of zinc, a thin film or guard of sculptor's clay, moistened with a 0·75 per cent solution of common salt, and worked out to a point, is placed on each cushion). These electrodes were connected with a galvanometer, and the preparation was placed so that the eyeball, carefully freed from muscle, rested on the one clay-guard, while the transverse section of the optic nerve was in contact with the other. By following Du Bois-Reymond's method, we have had no difficulty in obtaining a strong deflection from the eyes of various rabbits, a cat, a dog, a pigeon, a tortoise, numerous frogs, and a gold-fish. The deflection was frequently so much as to drive the spot of light off the galvanometer scale.

With regard to the second question—namely, Whether, and to what extent, the electro-motive force would be affected by light? we found more difficulty. The method followed was to place the eyeball on the cushions in the manner above described, to note the deflection of the galvanometer needle, and then to observe whether or not any effect was produced on the impact of a beam of light, during its continuance, and on its removal. In a few of our earlier experiments we used Du Bois-Reymond's multiplying galvanometer, but finding the amount of deflection obtained was so small that the effect of light could not be readily observed, we have latterly used Sir W. Thomson's exceedingly sensitive reflecting galvanometer, kindly lent us by Professor Tait. We met also with secondary difficulties such as the dying of the nerve, the impossibility of maintaining an absolutely constant zero, and an absolutely constant amount of polarity, the effects of heat, &c.; but these difficulties we have overcome as far as possible by the most approved methods. The changes in polarity of the apparatus occurred slowly, and could not be mistaken for the changes produced by the action of light, which we found occurred suddenly, and lasted a short period of time. It is also important to state that the deflections we observed do not at present profess to be absolute, but only relative values. About five hundred observations were made previous to the date of this first communication, and we took every precaution to obtain accurate results. The effects of heat were carefully avoided, by covering over the troughs, on which the eye under examination rested, with a spherical double-shell of glass, having at least an inch of water between the walls.

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* Read before the Royal Society of Edinburgh.

The results we have arrived at are as follows:—

1. The action of light on the retina is to alter the amount of the electro-motive force to the extent of from 3 to 7 per cent of the total amount of the natural current.

2. A flash of light, lasting the fraction of a second, produces a marked effect.

3. A lighted match, held at a distance of four or five feet, is sufficient to produce an effect.

4. The light of a small gas flame enclosed in a lantern, and caused to pass through a globular glass jar (12 inches in diameter), filled with a solution of ammoniacal sulphate of copper or bichromate of potash, has also produced a change in the amount of the electro-motive power.

5. The action of light on the eye of the frog is as follows:—

When a diffuse light is allowed to impinge on the eye of the frog, after it has arrived at a tolerably stable condition, the natural electro-motive power is in the first place increased, then diminished; during the continuance of light, it is still slowly diminished to a point where it remains constant; and on the removal of light, there is a sudden increase of the electro-motive power nearly up to its original position. The alterations above referred to are variables, depending on the quality and intensity of the light employed, the position of the eyeball on the cushions, and modifications in the vitality of the tissues.

6. Similar experiments made with the eye of warm-blooded animals, placed on the cushions as rapidly as possible after the death of the animal, and under the same conditions, have never given us an initial positive variation, as we have above detailed in the case of the frog, but always a negative variation. The after inductive effect on the withdrawal of light occurs in the same way.

7. Many experiments have been made as to effect of light from different portions of the spectrum. This was accomplished by causing different portions of the spectrum of the oxy-hydrogen lime-light to impinge on the eye. All these observations tend to show that the greatest effect is produced by those parts of the spectrum that appear to consciousness to be the most luminous; namely, to yellow and the green.

8. Similarly, experiments made with light of varying intensity show that the physical effects we have observed vary in such manner as to correspond closely with the values that would result if the well-known law of Fechner was approximately true.

9. The method followed in these inquiries is a new method in physiological research, and by the employment of proper appliances, it may be greatly extended, not only with regard to vision, but also to the other senses.

SPONTANEOUS COMBUSTION.

Messrs. C. Price and Co. have been attempting to draw the attention of Fire Offices to the danger resulting from the indiscriminate use of oils in factories, and in default of any response from these companies, they have appealed to the press. Our readers are of cause aware that if oils are mixed with saw-dust, textile fibres, &c., so as to be exposed to the atmosphere in thin films, oxygen is rapidly absorbed, the temperature of the mass rises, and under favourable circumstances actual ignition may ensue. The effect varies greatly with the kind of oil used; some oils being exceedingly dangerous, whilst others may be regarded as practically safe. Hence the risk of fire in a factory must be influenced to a very considerable degreee by the kind of oil used. Strange to say, this point is quite overlooked by Fire Offices, except as regards oils employed in the woollen manufacture. There a classification has been introduced, which, unfortunately, is far from being in harmony with facts. Olive oil is considered the least dangerous, mineral oils, pine, linseed, and rape, and their mixture the most so, whilst all other oils are supposed to hold an intermediate position. But according to chemists who have made this property of oils the subject of special examination—we may instance the late Professor Graham, Mr. J. Galletly, and Mr. Keates, consulting chemist to the Metropolitan Board of Works—olive oil ranks among the most dangerous oils, whilst the hydrocarbons, such as the mineral oils, are incapable of producing spontaneous combustion. Messrs. Price, therefore, call upon the Insurance Companies, in justice alike to themselves, and to the public, to have the relative heat-generating powers of the different commercial oils, determined by a commission of eminent chemists, and to apply the revised classification thus obtained to all establishments where oils are, for whatever purpose, brought in contact with fibrous or pulverulent organic matter. Such a classification would, however, still leave one thing to be desired.

A mill-owner might declare his intention of using only the safest oils, and be insured accordingly at the lowest rate, and all the time use, either fraudulently or in ignorance, mixtures of much more dangerous kinds. To prevent the possible consequences of such frauds or mistakes, Messrs. Price suggest that the Fire Offices should engage the services of chemists to test such oils, and stipulate for their admission to examine and test the lubricating mixtures, &c., used by parties who insure with them, just as Boiler Insurance Companies require admission for their inspecting engineer.

We need not say that we cordially agree with the suggestions of Messrs. Price. We consider that they have pointed out a very serious source of danger, which well deserves the attention of the public.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 4th, 1874.

Dr. Odling, F.R.S., President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Mr. H. H. B. Shepherd was formally admitted a Fellow of the Society.

The donations of books were then announced, after which the following names were read for the first time:—Messrs. Edwin Rider Cook, John Cox, and Henry John Cook.

For the third time—Messrs. James Bayne, Henry Bird, John Taylor Leighton, William M. Habinshaw, Percy Tarbutt, Robert Yates, Toraske H. Tono, Stephen Cooke, and W. Sharman, who were then ballotted for and duly elected.

The first paper, "*On Dendritic Spots in Paper*," by H. Adrian, was read by the author. He said he could confirm Mr. Liversidge's observation that these markings were due to sulphide of copper with a nucleus of metallic copper or brass. They are rare in the better class of papers, but a cheap coarsely-finished blue-white paper, used extensively for account-books, exhibits them in large numbers. The spots seem to be formed from the metallic nuclei by the action of the antichlore used in the process of bleaching.

The President having thanked the author, Dr. Müller said the spots were caused by particles of metal derived from the bed-plate of the machine used for tearing the rags becoming abraded by the steel wheel if the latter was lowered too much. Their being present to a greater extent in the cheaper papers was perhaps due to the sand, &c., in the coarse materials used, but the same effect sometimes occurred even in good papers. There were, moreover, other dendritic marks of an organic nature.

Mr. Frisswell observed that large dendritic spots of reduced metallic silver were sometimes produced in photographic paper, on immersion in the silver-bath, by the action of these particles of metal.

The next paper, "*The Acidity of Normal Urine*," by J. Resch, M.A., was read by the Secretary. The author finds that, on the gradual addition of hydrochloric acid to very dilute solutions of uric acid in weak soda, a precipitate is at first formed, which re-dissolves on agitation, but, on continuing the addition of the acid, it becomes permanent, consisting of uric acid without any urate. It is re-dissolved by hot solution of soda, and on adding acid, and cooling, it again comes down. From these results the author infers that, from solutions so dilute as urine, the uric acid may not crystallise out at all, except under favourable conditions, and this is due to its molecular constitution, and not to any increase in the acidity of the urine. With regard to the alkaline fermentation, the author's experiments lead him to believe that the decomposition is the result of a regular progressive change and not a sudden impulse, the fermentation being caused not by the mucus, but by the gradual oxidation of the uric acid.

The President remarked that the solubility of uric acid in water and in alkaline solutions was somewhat beside the question, which was as to its solubility in a solution containing urea. As to the oxidation of the uric acid being the cause of the decomposition of the urea, the evidence offered by the author was scarcely conclusive.

Mr. Hartley said he could not conceive how the decomposition could be effected by the oxidation, as in Pasteur's flasks, with the necks stopped with cotton-wool, or drawn out to a length of several feet, so as to exclude the entrance of any germs from the atmosphere, no change took place, although oxygen had free access.

A paper, "*On a Simple Method of Estimating Urea in Urine*," by Dr. Russell and Mr. West, was read by the former. After referring to the processes of Davy, Knoss, and Huffner, he proceeded to describe the apparatus employed, which is a simple modification of that proposed by the last-mentioned chemist, and much less liable to derangement, enabling it to be used in the wards of hospitals. It consists of a tube about 9 in. long, with a bulb at the closed end, and a slight constriction above the bulb, capable of being closed with a long glass rod having a short piece of caoutchouc tube slipped over the end. The open end of the tube is fitted by means of a perforated cork into the bottom of a small pneumatic trough. 5 c.c. of the urine under examination are introduced into the bulb, whose capacity is about 12 c.c., washed in with a little water, and then closed by the glass rod. The tube is now filled up with a solution of sodium hypobromite prepared by dissolving 100 grms. of sodium hydrate in 250 c.c. of water, and adding 25 c.c. of bromine. The trough is filled with water, the glass rod is withdrawn, and an inverted graduated tube, previously filled with water, is at once brought over the mouth of the laboratory-tube. The hypobromate now acts on the urea, liberating nitrogen, which passes into the graduated tube, and is there measured. If necessary, the reaction, which usually occupies about ten minutes, may be accelerated by gently heating the tube. It is found that the amount of nitrogen given off from a given weight of urea is about 8 per cent less than the theoretical, but, by a curious coincidence, the corrections, which would have to be made for the reduction in the volume of the gas for aqueous vapour and a temperature of 65° F., compensate for this; the variation caused by change of atmospheric pressure is so small that it may be disregarded. In practice, it is found advisable to graduate the tube so as at once to give either the percentage of urea present, or the number of grains per fluid ounce. [The apparatus above described was exhibited, and a practical illustration of the method given by Mr. West].

Dr. Odling thanked the authors for their admirable paper, and especially for the practical illustration of the process. He hoped that the facilities afforded by the new preparation-room would induce authors of papers to give the Fellows of the Society the opportunity of witnessing the experimental phenomena with their own eyes.

In answer to questions put by the President and by Dr. Wright, Dr. Russell said that the new method gave very satisfactory results when compared with the ordinary processes, and that the suppression of the 8 per cent of nitrogen did not vary with the temperature at which the experiment was made.

Mr. West said that Davy had observed that, in the decomposition of urea by the hypochlorites, the whole of the nitrogen was not given off, and Huffner had estimated the deficiency at 6 per cent. The sources of the excreted nitrogen were that produced by the tissue change in the body, and that derived directly from the food. Careful observations had been made on the latter, but the former had been somewhat neglected. The quantity, however, from the tissues seemed to be less than 200 grains, although the amount of urea excreted undoubtedly varied with the constitution of the individual.

A paper, "*Oh Ipomæic Acid*," by E. Neison and J. Bayne, was read by the former. The ipomæic acid of Mayer, prepared by acting with nitric acid on jalapine, has the formula $HC_5H_8O_2$, and, as its properties closely resemble those of sebacic acid, $H_2C_{10}H_{16}O_4$, the authors thought it possible they might be identical. They accordingly acted upon jalapine with nitric acid, and carefully purified the resulting acid. It was then found to have the same crystalline form as sebacic acid, and to melt at 126° to 127°, sebacic acid melting at 127° to 128°. Its solubility in water, moreover, was sensibly the same as that of sebacic acid, and the sodium, barium, lead, and silver salts of the two acids were precisely similar in appearance and properties. There can therefore be no doubt that ipomæic acid is identical with sebacic acid.

The President having thanked the authors for their interesting communication, Mr. G. S. Johnson read a paper "*On Certain Compounds of Albumin with the Acids.*" The compound with nitric acid was obtained by placing white of egg in a hoop dialyser, and floating it upon the surface of very dilute nitric acid, density 1·0025. In about twenty-four hours it had changed to a semi-transparent jelly, which was soluble in boiling water, the solution gelatinising again on cooling. On neutralising with an alkali and heating, the albumin was precipitated, but the solution was not precipitated by corrosive sublimate, silver nitrate, or lead subacetate. Dried *in vacuo* the compound forms a hard, transparent, brittle mass, which contains 6·796 per cent of nitric acid; the formula, $C_{72}H_{112}N_{18}SO_{22},2HNO_3$, requires 7·24 per cent. The corresponding compounds with hydrochloric acid, sulphuric acid, orthophosphoric and metaphosphoric acids were prepared in a similar way, and closely resemble the nitrate in properties and composition. The compounds with citric, oxalic, tartaric, and acetic acids have also been prepared and examined. Besides the description of these substances—which only seem to be formed when albumin is dialysed in the manner described, and not when it is merely mixed with the requisite amount of acid,—this voluminous paper contains a detailed account of the action of a high temperature (150° to 200° C.) on white of egg and on the compounds of albumin with the acids.

The PRESIDENT said the Society was much indebted to Mr. Johnson for his investigation of the subject of these compounds of albumin. There was one point of special interest—namely, as to whether these were permanent when submitted to dialysis.

The Author replied that, after a sample of the hydrochlorate had gelatinised on the dialyser, he had floated it on distilled water for several days, and found, on analysis, that it still contained sensibly the same amount of hydrochloric acid.

Dr. D. TOMMASI then read a paper in French "*On Sulphite of Acetyl.*" He prepares this compound by allowing acetyl chloride to fall drop by drop on dry lead sulphite, and, after allowing it to stand some time, distilling. Acetyl sulphite—

$$\left.\begin{matrix}SO''\\(CH_3CO)_2\end{matrix}\right\}O_2$$

is a colourless liquid, of penetrating odour, which is decomposed by water, with disengagement of sulphurous anhydride and formation of acetic acid; sulphuric acid likewise attacks it with disengagement of sulphurous acid; and, with nitric acid, the action takes place with explosive violence.

There was also another paper by the same author, "*On a New Method of Preparing Toluene.*" On heating benzyl chloride with ethyl alcohol, and then adding zinc-dust in small quantities at a time, a reaction takes place, with evolution of gas. By distillation, a liquid is obtained which, on adding water, leaves a colourless oil, insoluble in the latter, and boiling at 111° to 112° C. This was found on analysis to have the formula C_7H_8, and an examination of its properties proved it to be toluene. The author believes that in this reaction zinc benzyl is first formed, which, in the presence of the water contained in the alcohol, is decomposed into zinc hydrate and toluene.

The last paper, a "*Note on New Zealand Kauri Gum,*" by M. M. P. MUIR, was read by the Secretary. After describing the physical properties of this gum resin, obtained from the *Dammara australis*, the author states that a portion is soluble in water, and about 52 per cent in alcohol, the latter containing traces of benzoic and succinic acids. It is soluble in concentrated sulphuric acid, and is violently attacked by nitric acid. By dry distillation, an oil was obtained which, on fractionation, yielded a liquid boiling between 155° and 165° C., and having the composition $C_{10}H_{20}O_7$.

The meeting was finally adjourned at a late hour until Thursday, June 18, when the following communications will be read:—(1) "On Iso-Dinaphthyl," by W. Smith. (2) "Communications from the Laboratory of the London Institution," by Dr. H. E. Armstrong. (3) "On the Products of the Decomposition of Castor Oil; No. III., On the Decomposition by Excess of Alkaline Hydrate," by E. Neison. (4) "On the Restitution of Burnt Steel," by J. L. Davies. (5) "On Suberone," by Dr. Schorlemmer. (6) "On the Action of Nitrosyl Chloride on Phenol," by Dr. W. A. Tilden. (7) "On an Apparatus for the Determination of Carbonic Anhydride and Moisture," by Dr. D. Tommasi, as also (8) "The Determination of Ozone in the Presence of Chlorine and Nitrous Acid," and (9) "Constitution of Urea."

Certain New Derivatives of Brominised Anilines.—L. Remmers.—The author has obtained and examined nitrobrom-acetanilid, bromphenylen-diamin, ethenylbromphenylen-diamin, dibrom-acetanilid, nitro-dibrom-acetanilid, tribrom-diacetanilid, and nitro-tribrom-monoacetanilid.

NOTICES OF BOOKS.

The Practical Assayer. By OLIVER NORTH. London: Chatto and Windus.

MR. NORTH'S object has been, he informs us, to provide a concise and clear account of the best and quickest way of assaying the principal metals." He thinks "most works on this subject mix up the province of the analytical chemist too much with that of the assayer, whereas the two are totally distinct." We should like to see the author's definition of assaying. He evidently does not restrict the use of the term to determinations of the dry method, as was formerly usual. Nor does he limit it to the estimation of some one constituent of a complex body on which its commercial value mainly depends.

In addition to the metallic ores, he includes in his scope sulphur, nitrate of soda, and guano. On what principle coal, potash-saltpetre, borax, phosphatic minerals, &c., &c., are excluded, we scarcely see. We should pronounce assaying merely a branch of analytical chemistry, comprising processes capable of rapid execution, and serving to indicate the value of commercial substances with a degree of accuracy sufficient for ordinary practical purposes. It must further be noticed that the more accuracy comes to be insisted on, the more the assayer becomes an analytical chemist. Mr. North goes on to say: "The very first chemist of the day might easily be far inferior to a good assayer in estimating the exact value of an ore." Doubtless, keep a man constantly performing one operation, or one limited set of operations, and, unless grossly careless or incapable, he acquires a special expertness, which persons whose practice is more varied cannot expect to rival. The author further tells us that he has left out some "better processes than those given," which scarcely agrees with his intention of explaining the "best way" of assaying ores.

In speaking of copper, we are glad to find that he rejects altogether the Cornish assay. In place of it, he gives the Chilian method by precipitation in the metallic state by means of iron, and the volumetric process with cyanide of potassium. The Mansfeld process (Dr. Steinbeck's) is omitted. All procedures for the determination of lead and tin by the moist way are rejected. It is to be regretted that the author has not paid more attention to the correct use of language. Thus, on page 117, we read: "The ore (lead) must be got through a 60 sieve, and, as in the case of tin-ore, carefully mixed up to secure a homogeneous sample, which very often causes great errors." Mr. North meant to say the very opposite.

The assay of cobalt and nickel does not strike us as perfectly trustworthy. These metals cannot, so far, be accurately determined without full time is allowed for the operation.

In speaking of guano, the author directs the determination of the phosphate by the addition of ammonia to the acid solution of the entire ash. Sometimes, however, it happens that the phosphate present is a mixture of the tri-calcic and the di-calcic salts. In this case, the amount of lime present may not suffice to carry down all the phosphoric acid present on the addition of ammonia. In this case, a further deposit will be formed on adding a little solution of chloride of calcium to the filtrate. It must also be remembered that, if this process is applied to the ash without previous extraction with water, any phosphoric acid present in combination with alkali will be determined as if combined with lime; and if a special determination of the acids and bases soluble in water, be subsequently made, it may appear in the results twice over.

The appendix on copper-smelting in Chili is exceedingly interesting, and should be read by all who intend investing in Chilian mines. We learn that a *lawyer* was actually sent out to manage the smelting works of an English company at Guayacan. A collapse was the natural consequence.

Experimental Researches on the Causes and Nature of Catarrhus Æstivus (Hay-fever or Hay-asthma). By C. H. Blackley, M.R.C.S.E. London: Baillière, Tindall, and Cox, King William Street, Strand.

Hay-fever is in many respects a remarkable disease. It first appeared, or, at least, was first recognised, in England about the year 1819, and is still more prevalent in this country than in any other part of the world. The disease is next most frequent in Germany, whilst France, Belgium, Switzerland, Scotland, Italy, Russia, and Ireland follow in the order in which they stand. Climate, therefore, can play no prominent part as a predisposing cause, or Ireland would certainly stand nearer England in the list than either Italy or Russia. Out of a total number of 152 patients whose parentage was ascertained, 81 were found to have been of English parents (natives of England proper) whilst of the remainder 36 were found to have been born of German parents, leaving only 35 whose parents were natives of other countries. Only one patient was born of Irish parents, thus showing that race seems to have a more potent influence in producing a predisposition to the disease than mere geographical position. Another remarkable fact is that disease, if not aristocratic, is almost peculiar to the educated classes, and seems to become more common in proportion to the spread of mental culture, and the intensity of intellectual labour.

Various agents have been supposed to be the exciting cause, such as the first heats of summer, dust, ozone, the odours of flowers, the pollen of all blossoms and especially of grasses. The author has devoted much time to experiment and observation on these reputed causes, and he decides on what appears sound evidence that the cause of this affection is pollen. He appends a curious table of curves showing the number of pollen grains collected in 24 hours on a surface of one square centimètre from May 28th to August 1st, 1866. The highest number, 880, was reached on June 28. Temperature and rain-fall materially affect the amount of pollen floating in the atmosphere, and hence must indirectly influence the frequency and severity of the disease. In perfect harmony with the pollen-theory, hay-fever was found least common in those localities where pollen is least likely to be plentiful, as in the centre of large cities, on the sea-shore, and on high-lying districts where the land is chiefly devoted to pasturage. By means of kites he succeeded in ascertaining the amount of pollen suspended in the higher regions of the air, as compared with the quantity found simultaneously at, or near the surface of, the earth. The result was that at heights of 1500 feet pollen was found more abundant than near the ground. One of these comparative experiments was tried at Filey in July 1870, during an easterly wind. The glass sent up by a kite to the height of 1000 feet had a deposit of 80 pollen grains upon it, whilst one exposed at the sea-level, "showed no pollen or any solid matter whatever." The author had opportunity to make a highly suggestive observation which may possibly bear upon the causes of diseases more important than hay-fever. Germs and spores of other kinds were found, generally in much larger quantity than pollen. "If," remarks the author, "many of these should resemble pollen in its capacity for absorbing water, and discharging granular matter under the influence of moisture, we may have a form of finely divided vegetable and animal matter thrown into the air, which the best modern instruments might fail to discover the nature and origin of, but which might, nevertheless, be a powerful cause of disease."

There evidently appears here room, or rather necessity, for a prolonged and laborious series of experiment and observation. What is the nature of the germs and spores detected? How are they affected, in kind or in quantity, by the circumstances of altitude, climate, season, and temperature? Can their appearance in unusual numbers, or in any particular kind, be connected with the prevalence of any given disease? These are questions not unworthy the attention of epidemiologists. Meantime, other questions are also suggested, less practically important, but highly interesting to the scientific enquirer. How is it that germs and spores are more numerous in comparatively elevated regions of the atmosphere than near the earth's surface, and, in consequence, near their origin? What is the nature of the force which carries up the germs and keeps them aloft? Why and when do they re-descend?

Mr. Blackley may be fairly congratulated on having produced a work which is not merely a valuable contribution to our medical literature, but which may be read with interest by many scientific men not connected with the profession.

CORRESPONDENCE.

THE SEWAGE QUESTION.

To the Editor of the Chemical News.

Sir,—As I was unable to be present at Prof. Corfield's lecture on "The Sewage Question," perhaps you will allow me to make some remarks on the report of it in the Chemical News of last week.

Prof. Corfield, in speaking of dry conservancy, still refers to earth and ashes as the only deodorants, and unfairly criticises *all* dry systems because he appears to think these must be based on such clumsy and inefficient substances. Now one of the important advantages of a dry carrier over any wet system is that, whilst the latter necessarily confines us to the use of water, the former affords the chemist a large choice of deodorisers, and of these, as I have repeatedly pointed out, earth and ashes are certainly the worst.

The lecturer has not hit the true reason why the manure from earth-closets is so valueless. I fully agree with Drs. Frankland, Gilbert, and Voelcker as to the poverty of this manure; numerous analyses have led me to the same conclusion. A manure after three uses in the earth-closet ought to contain at least five times as much nitrogen as it does. The fact is that, while charcoal, for instance, preserves an organic nitrogenous substance, earth decomposes it.

In a paper which will shortly be brought before the Chemical Society, I shall clearly show that mixtures of nitrogenous organic matter with earth rapidly lose nitrogen, that this loss is continuous, and that there is no trace of nitrification. As to how this nitrogen goes off, there is much yet to learn, and a prolonged investigation has not yet enabled me to speak positively, but of the loss there is no doubt. The real reason why the sewage of midden towns differs so little from that of water-closet towns is fully explained in one of my papers on the "Sewage Question" (Chemical News, vol. xxii., p. 302).

Considering the lecture was "On the Sewage Question from a Chemical Point of View," and delivered to the "Chemical Society," it is remarkable for total absence of all reference to purely chemical methods of dealing with the question. He ought not either to be very proud of the discussion from "a chemical point of view," when one eminent agricultural chemist says "the best way is to send it into the sea," and another says "that it could never be made profitable." Do these learned gentlemen forget that hundreds of towns can never hope to get their sewage to the sea, and that in civilised London every scrap of animal manure, other than human and much less valuable, is carefully collected and "profitably" kept out of the sewers?—I am, &c.,

E. C. C. Stanford, F.C.S.

Carruth, Bridge of Weir, N.B.,
June 6, 1874.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—You have frequently upheld the propriety of returning the results of analyses in such a form as to represent the real chemical value of the article analysed. I feel it right to call the attention of analytical chemists to the fact that the estimation of acetic acid in acetate of lime is frequently made by simple ignition of the commercial salt, and the acid calculated from the calcium carbonate, with subtraction of the lime sulphate present. These results are very confusing to commercial men when compared with the amounts of acetic acid obtained by distillation with hydric phosphate and titration in the usual way. Here are the figures obtained by the examination of three samples—

	Acetate of Lime, per cent.	
	By Distillation.	By Ignition.
No. 1	70·17	85·47
No. 2	69·98	85·30
No. 3	32·29	73·78

The indirect method I regret to say appears to be employed by some chemists of established reputation. It is obviously incorrect, and it is unjust to the conscientious worker who is at the trouble of making the more laborious analysis. As a rough method, the ignition may have its value, but, if it be employed to certify a parcel for sale, the certificate should also state the method used.—I am, &c.,

William Baker,
Assoc. Royal School of Mines Lond.

County Analyst's Office,
46, High Street, Sheffield,
June 9, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 20, 1874.

Letter Relative to a Calculation of Pouillet on the Cooling of the Solar Mass.—M. Faye.—This calculation, tacitly but unwarrantably, assumed that the mass is not susceptible of contraction. If the mass contracts, even by a quantity imperceptible by us (less than 28 metres per annum), the thermal effect must compensate, in great part, that of exterior radiation; a state of things which will last so long as the alimentation of the photosphere continues at the expense of the central layers. An external source of alimentation is superfluous; the formation of the sun, his enormous mass, and the mode of maintenance of his photosphere sufficiently explain the actual radiation, so remarkable in constancy and intensity.

Observations on M. Crocé Spinelli's Communication on Bands of Aqueous Vapour in the Solar Spectrum.—P. Secchi.—The writer says he had never affirmed that, in the solar spectrum in general, one might see the lines of aqueous vapour, but merely that in some of the solar spots there were some bands coincident with those of aqueous vapour. Probably in the sun's high general temperature water would not form, but from lowering of temperature through dilatation of gases in eruption (at a spot) it might. And the observations of M. Crocé Spinelli do not invalidate this, for he did not specially observe the spots.

Collimator Level and its Employment for a Horizon in Fog.—M. Goulier.—This new instrument consists of a pendulum suspended by a double joint, and carrying a collimator formed of a small tube, hermetically closed at one end by ground glass, and at the other by a convergent lens, 6 m.m. diameter and 18 m.m. focus. At the principal focus of the lens is a diaphragm pierced with a hole 2 m.m. diameter, and with a black silk thread across it. When the pendulum is at rest, the plane passing through the thread and the optical centre of the lens is a horizontal one. Thus the eye, looking through the lens, sees a dark line tracing the horizontal plane of the instrument. The advantages urged are—(1) The instrument is small. (2) It can be readily used by anyone without previous instruction. (3) It is invariable. It might be used by seamen (being fitted to a sextant so that one should see the collimator through the transparent part of the small mirror) for taking the height of stars when the horizon of the sea is not visible.

An Orometric Dial Suitable Especially for Pocket Barometers.—M. Goulier.—The author makes a circular scale within that expressing the millimetres of mercury; and on it one reads, opposite the pressures observed at stations A and B, two orometric numbers, which express the depth of these stations below the same level. The difference of these two numbers gives the difference of level at the two stations. Two specimen dials are given, one for average, and one for lofty mountains.

Absorption of Oxygen and Emission of Carbonic Acid by Leaves Kept in Darkness.—MM. Deherain and Moisson. (1) The quantity of CO_2 emitted increases with rise of temperature (as previously observed). At 7° 100 grms. of tobacco leaves gave in ten hours 0·031 gr. of CO_2; they gave 0·193 gr. at 18°, and 1·132 gr. at 41°. The increase varies with the species. It is greater, *e.g.*, with *Pinus pinaster* than with *Ficus elastica*. (2) The quantity of CO_2 emitted is comparable to that furnished by cold-blooded animals. Thus, taking Regnault and Reiset's data, frogs give in respiration weights of CO_2 much less than leaves of tobacco, mustard, or sorrel. At 15° the respiratory activity of silkworms is comparable to that of cuducous leaves observed at 30°, but notably greater than they manifest at 15° to 20°. (3) Leaves kept in the dark absorb more O than they emit CO_2. For example, 30 grms. of leaves of *Pinus pinaster* absorbed in twenty-four hours 7·7 c.c. of O, and emitted only 3·9 c.c. of CO_2. The effect is most sensible at low temperatures. The branches of some fatty plants (*Agave*, *Opuntia*) sometimes absorb O without emitting CO_2. The O fixed is utilised for formation of vegetable acids. (4) Leaves continue to emit CO_2 in an atmosphere deprived of O. The resistance to asphyxia is various. Pine leaves continue four or five days to emit CO_2, while those of tobacco, sorrel, *Ficus elastica*, *Begonia*, soon wither. (5) Hypothesis on the physiological utility of the internal combustion produced in leaves. Obscure heat is peculiarly favourable to energy of respiration, and there seems to be, between rapidity of growth and energy of respiration, a connection which may be understood if we suppose that a certain quantity of heat must be called into action in order that the immediate principles may form. The internal combustion, shown by absorption of O and emission of CO_2, is the origin of a part of the heat necessary to elaboration of new immediate principles.

New Method of Measuring the Velocity of Light.—M. Burgue.—Consider a disc turning very rapidly about its axis, and at each turn illuminated by an intermittent and instantaneous light. A small dark radial line, *a*, on the disc will seem at rest like the disc itself. Withdraw the source of light to a distance; the time the light takes to come and illuminate the disc is now greater, and the line is displaced to a position *a'*, forming with *a* a certain angle, *aOa'*, which will accordingly measure the time of the light's passage a given distance. [This note was submitted to M. Fizeau for consideration.]

Facts Relative to the Vibration of Air in Sounding Tubes.—M. Gripon.—A mass of air which vibrates separately, in unison with a pipe placed at some distance and opposite to the open extremity of the pipe, raises the sound as a vibrating membrane does, but the alteration is less. Representing by 1 the number of vibrations of the original sound, the altered sound is represented by 1·008, if the sounding case of a diapason *do*^{3} be placed before a pipe of the same pitch, and by 1·004 if you operate with *do*^{4}. The sound of the pipe falls if the air-case be graver than it; it rises if the case be more acute. (Various related facts are given.)

New Thermo-electric Pile.—M. Clamond.—The author has been improving his apparatus. He found in it a considerable increase of resistance, and this was due to two causes—(1) Oxidation of the contacts of the polar plates with the crystallised bar under the influence of heat; and (2) splitting of the bar and separation of its different parts in planes perpendicular to its length. (His mode of remedying these evils is described.) In making his couple he uses an alloy of zinc and antimony, and plates of iron as armatures. The bars are collected in crowns of ten bars each, superposed and separated by washers of amianthus, and coupled for tension. The whole forms a cylinder, the interior of which is luted with amianthus, and heated by means of a pipe of refractory earth pierced with holes. The gas mixed with air burns in the annular space between the tube and the bars. The entire surface of the crowns of the pile is 35 square decimetres. The consumption of gas is controlled by M. Girond's regulator (referred to in next note). Thus arranged, the pile will work whole months without requiring attention, giving a current absolutely constant. The model shown consumed 170 litres, that is, about 5 centimes of gas in the hour, and deposited 20 grms. of copper, which makes the expense of gas per kilogrm. of copper deposited 2 francs 50 cents. M. Clamond has made models of various size; the quantity of electricity increases proportionally to the size of the pieces.

Regulator of Volume for Currents of Gas.—M. Girond.—The problem is to render the volume flow at a given point of a gaseous current independent of variations of pressure of the gas, and of the size of the final orifice of outflow. [The author's mode of solving it cannot well be understood without figures.]

Movement Produced in the Stamens of Mahonia and Berberis; its Anatomical Conditions.—M. Heckel.—The contractile cells of the two faces of the stamen are mobile, not by its envelope, probably, but by its granular protoplasm, which contracts and induces the retreat of the enveloping membrane. There is antagonism of the dorsal and the anterior cells. The former contract under the influence of irritation, and the movement of the organ is produced; the latter are stretched by the contraction of the fibre and elongated, but they tend to react and return to their normal state, which is that of contraction. Thus the stamen gradually returns to its position.

Direction of the Wind in the Storm of April 13, 1874.—M. Chapelas.—He noted that morning a barometric pressure of 742 m.m., and a direction of wind and clouds S.S.W. to S.W. Next morning the wind and clouds had the opposite direction, N.E. N.N.E. The barometer rose 4 m.m., and continued to rise till the 19th.

Gen. Morin presented the first volume of Tome iv. of the "Revue D'Artillerie," containing, among other things, a highly interesting *resume* of an inquiry instituted into the qualities and faults of the artillery *materiel* employed in the war of 1870-71.

Formation of Certain Crystalline Substances in Capillary Spaces.—M. Becquerel. (Tenth memoir.)—The author has previously succeeded in obtaining crystalline alumina with three equivalents of water, $Al_2O_3,3HO$, blue crystalline hydrate of copper, and the crystallised oxides of zinc and lead, hydrated silicate of copper in double refracting crystalline needles, &c. Having recently resumed his experiments, he now announces the formation of fluoride of calcium, crystalline aluminate of copper, blue silicate of copper, $CuO,SiO_2,2HO$, aluminate of magnesia in crystalline needles, and differing from spinel only in containing no water, and a variety of other crystalline minerals.

New Researches on the Cyanogen Series.—M. Berthelot.—An investigation into the amount of heat developed in the formation of the double cyanides.

Heat of Formation of the Cyanic Compounds from their Elements.—M. Berthelot.—A table, incapable of abstraction.

Part Played by Salts in the Action of Drinking-Waters upon Lead.—M. Fordos.—The salts examined were sulphate of soda, chloride of sodium, nitrates of potash and ammonia, and a saturated solution of sulphate of lime. In all cases the lead was attacked, and traces of the metal entered into solution.

Preservation of Wood.—M. Hubert.—The author proposes to coat the wood with oxide of iron, by driving into it abundance of long slender nails with broad flat heads.

Tetraiodide of Carbon.—G. Gustavson.—This substance forms deep red crystals of an octohedral form, belonging to the regular system. Its specific gravity at 20·2° is 4·32.

New Researches on Black Phosphorus.—M. Blondlot.—This paper has been already noticed in the Chemical News.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 4, March 9, 1874.

On Nitro-Anthracen.—E. Schmidt.—The author finds that the mono-nitro-anthracen of Bolley and Tuchschmidt is not a pure nitro-derivative of anthracen, but a double compound of dinitro-anthrachinon and chrysen. He is also unable to confirm the results of Phipson, since on treating anthracen with nitric acid, he obtained, instead of an isolable nitro-anthracen, merely a mixture of anthrachinon and dinitro-anthrachinon.

Preparation of Pure Phenanthren.—E. Schmidt.—If mixtures of hydrocarbons containing phenanthren are dissolved in alcohol of 80 to 85 per cent, and the filtrate is boiled for some time with an amount of nitric acid equivalent to the hydrocarbon, and allowed to cool, all the anthracen separates out, first as anthrachinon and dinitroanthrachinon, in the form of a resinous cake. On further cooling the liquid congeals to a crystalline paste of unchanged phenanthren.

Influence of the Position of Oxygen upon the Boiling-Point.—Alex. Maumann.—The author concludes that "in metamerous bodies of like chemical character and corresponding structure, the more the oxygen combined in a similar manner advances towards the centre of the chain of atoms, the lower falls the boiling-point."

Action of Sulphuretted Hydrogen upon Chloral Hydrate.—G. Wyss.—The author treated chloral hydrate with sulphuretted hydrogen, and obtained a crystalline body, soluble in alcohol and ether, to which he assigns the formula $C_4H_4Cl_6O_2S$.

Isomeric Dinitro-benzoic Acids, and their Connection with Phenylen-diamins.—C. Wurster and G. Ambuhl.—The authors have succeeded in converting ordinary diamido-benzoic acid into phenylen-diamin.

Communications by A. P. M. Franchimont.—Remarks on the action of pentachloride of phosphorus upon alcoholate of sodium; on anhydrous citric acid, and on the preparation of malonic acid.

Action of Nitrous Acid upon Ethylaniline.—Peter Griess.—The author finds that the chief product of the reaction is $C_8H_{10}N_2O$, a new compound.

On Sebacylic Acid.—O. M. Witt.—A preliminary notice on the salts of this acid, especially the cobalt compound.

Mutual Behaviour of Phosphate and Carbonate of Lime at Elevated Temperatures.—F. Wibel.—The author finds—(1) That the pyro and ortho phosphates, as well as the apatite compounds, when heated with carbonate of lime, are decomposed in such a manner that the carbonate gives up to the phosphate a part of its lime, which cannot be re-converted into carbonate by means of carbonate of ammonia. (2) The extent of this decomposition depends on the constitution of the phosphate, the proportions of the mixture, the intensity and duration of the heat, and on the presence of organic matter. It is notably increased by the two latter points. (3) The process of decomposition depends, in pyrophosphates, on the tendency to pass into neutral ortho-phosphate; in orthophosphates, on the disposition to form basic salts; and in the apatites, on the substitution of lime for chloride of calcium. (4) In the analysis of bodies containing phosphate and carbonate of lime along with organic matter, the determination of the latter is erroneous when calculated from the loss of weight on ignition, after treatment with carbonate of ammonia. The amount will be found increased by the carbonic acid which is incapable of restoration. (5) In all mixtures of carbonates and phosphates carbonic acid can only be determined previously to ignition. In the ignited mass it will be found too low, even after treatment with carbonate of ammonia. These results are of great importance as regards the analysis of bone-ash, and the constitution of bone-earth.

Nitro Compounds of the Allyl Series.—E. Brackebusch.—The author has examined nitro-propylen, sodium- and potassium-nitro-propylen, allylamin, and nitrite of allyl.

Communications from the Laboratory of the University of Freiburg.—Ad. Claus.—These communications consist of a lengthy paper on the uric acid group, a notice on the thioprussiamic acids, and on sulphurea.

Formation of Methyl-hydantoic Acid.—E. Baumann.—The author finds that methyl-hydantoic acid cannot be formed by the action of urea upon sarcosin introduced into the animal organism.

Splitting up of Dibenzyl-disulpho Acid.—R. Kade.—If the potash salt of this acid is fused at a low temperature there is formed oxydibenzyl-sulpho acid; at a higher temperature dioxy-dibenzyl is obtained.

Isomeric Nitro-aceto-naphthalids.—C. Liebermann and A. Dittler.—This paper is not suited for abstraction.

Action of Nitrous Acid upon Phenols.—C. Liebermann.—If orcin is dissolved in concentrated sulphuric acid, and if small quantities of pulverised nitrite of potash are gradually added, the solution turns purple. Water throws down red flakes, which re-dissolve in alkalies with a cherry-red colour, and display a vermillion fluorescence. The colour thus obtained is not orcein, but is in certain respects analogous to the colouring matters obtained some years ago from resorcin by Weselsky. Sulphurous acid containing nitrous acid forms colouring matters with most phenols. To concentrated sulphuric acid, in a stoppered bottle, 6 per cent of nitrite of potash was added, and the absorption of the vapours promoted by shaking. The various phenols require respectively a somewhat different treatment with this reagent. Some must be treated in the solid state with several volumes of the reagent, whilst others are added to it as concentrated aqueous or sulphuric solutions. A concentrated aqueous solution of resorcin is immediately turned by this reagent a fine blue. If added to phenol the mixture becomes hot, and assumes first a brown, then a green, and in a few moments a royal blue colour. If the blue solution is poured into water, with due precautions to prevent a rise of temperature, the colouring matter is deposited in reddish brown flakes, which re-dissolve in alkalies with a rich blue colour.

A Lactic Acid of the Allyl Series.—A. Pinner.—The author has obtained acrylolactic acid, which contains two equivalents less hydrogen than the lactic acids, $C_3H_6O_3$.

Oxidation Products of Isobutylic Alcohol, and on the Trichloraceton Formed from the so-called Isobutylic Aldehyd.—G. Kraemer.—A controversial essay in reference to the paper by Barbaglia, vi., 910.

No. 5, March 23.

Nature of Bleaching Lime.—C. Gœpner.—A critique on Schorlemmer's paper (*Berichte*, vi., p. 1509). The author questions the scientific value of Schorlemmer's method of demonstrating the presence of hypochlorous acid, considering the difficulty of detecting chlorine along with that acid.

Ammonia Soda Process.—A. Bauer.—The decomposition of bicarbonate of ammonia by chloride of sodium is incomplete, the loss of salt amounting to about one-third of the total weight employed. The author seeks the cause of this in the fact that the carbonate and bicarbonate of soda are decomposed in contact with sal-ammoniac, forming carbonates of ammonia and common salt. This transposition takes place under a great variety of circumstances.

Determination of Acetylen in Gaseous Mixtures, and the Composition of Acetylen Copper.—R. Blochmann.—The author finds that in the analysis of coal-gas it is not advisable to attempt the determination of acetylen according to Bunsen's gasometric methods. Berthelot and Landolt determine acetylen directly by passing it through an ammoniacal solution of copper, decomposing the precipitate obtained, and determining the volume of acetylen set free.

Formation of Anthracen by Heating Chloride of Benzyl with Water.—Th. Zincke.—Anthracen is apparently a product of the splitting up of a higher hydrocarbon, nC_7H_6.

Transformation of the Diazonitro-Benzols into Nitrophenols.—R. Fittig.—The nitric-diazo compound from nitro-acetanilid passes into nitrophenol on boiling with water.

Alcoholic Fermentation.—Oscar Brefeld.—The author concludes that—(1) Alcohol yeast, like all other plants, requires for its development and increase the co-operation of free oxygen. (2) If air and free oxygen are excluded, the yeast cannot grow. These two facts overturn the theories of Pasteur on fermentation. (3) Yeast, in contradistinction to all other plants, when in solutions where its growth is possible, has a great affinity for free oxygen. It can completely extract free oxygen mixed with 6000 volumes of carbonic acid. (4) *Mucor racemosus* has the same property, and excites alcoholic fermentation in a saccharine solution. (5) Growth and increase of yeast may take place without fermentation, and, again, fermentation without growth of yeast. The carbonic acid thrown off in fermentation is remarkable for its purity. (6) In suitable solutions, exposed to the air, growth of the yeast plant and fermentation occur simultaneously in different parts of the liquid. (7) Fermentation is the expression of an abnormal incomplete vital process, in which all the bodies required for the nutrition of the yeast do not simultaneously and harmoniously co-operate. These results will prove of great technological interest.

A Universal Burner.—R. Muencke.—A useful piece of apparatus, which we cannot describe without the accompanying illustrations. It is manufactured by Warmbrunn and Quility, of Berlin.

Communications from the Laboratory of the University of Wurzburg.—J. Wislicenus.—Dr. Goldenberg has been engaged with an examination of certain derivatives of benzoin. Bonné and Goldenberg have examined a silver compound of biuret. Carl Zimmermann has prepared certain novel silver compounds of melamin, and has also studied the constitution of phosphoro-ethylester. Kessel has obtained a secondary nomal butyl-ether by the mutual action of pure ethyliden oxychloride and zinc diethyl. Zuckschwerdt has studied the action of nascent hydrogen upon dinitro-ethylic acid, and has extended his investigation to the addition-product of sulphurous acid and zinc ethyl. C. Forster has obtained mercurid-phenylammon-chloride, and has examined its action upon substituted thio-ureas. Valerius Hemilian has endeavoured to decide the constitution of the isomeric crotonic acids.

Combinations of Thallium with Alcohol Radicals.—F. C. Hartwig.—The author has obtained the diethyl-chloride of thallium, the sulphate, phosphate, nitrate, acetate of thallium-diethyl; the iodide, hydroxide, and chloride of thallium.

Preparation of Thallium-Triethyl.—L. Carius and C. Fronmüller.—A continuation of the researches described in the foregoing paper.

Aluminium Chloride of Platinum.—A. Welkow.—The compound consists of—

Aluminium	3·95
Platinum	26·29
Chlorine	33·33
Water	36·58
	100·15

It shows no analogy with the glucino-chloride of platinum, an additional proof thut glucinum and aluminium are essentially distinct in their chemical nature.

Certain Derivatives of *a*- and *β*-Diamido-naphthalin.—A. De Aguilar.—A lengthy paper, not adapted for abstraction.

Synthesis of Tetra-methyl-succinic Acid.—C. Hell and A. Wittekind.—The authors caused monobrom-isobutyric-ethylester to act upon finely divided silver. The properties of the acid thus obtained differ decidedly from those of ordinary suberic acid.

Synthetic Cymol obtained from Normal Bromide of Propyl and Crystalline Bromtoluol.—F. Fittica.—The author considers that his experiments have proved the presence of normal propyl in the mutually identical cymols.

Method for obtaining Bases Free from Oxygen.—O. Wallach.—The author has examined the behaviour of PCl_5 with oxygenised amides.

Constitution of the Substituted Phenols.—Jul. Post.—A very long paper, which cannot be usefully abstracted.

Promiscuous Communications.—M. P. v. Wilde.—The author treats of the preparation of acetylen, the action of hydrogen upon acetylen and ethylen in contact with platinum-black, and gives a preliminary notice on the action of electric currents upon gases and gaseous mixtures.

Reimann's Farber Zeitung, No. 11, 1874.

This number contains receipts for a logwood-blue as substitute for vat-blues on wool and cloth; a blue for topping piece-goods previously grounded with blue; a logwood-blue on a white ground; a blue for topping wool already dyed blue; a continuation of the article on dyeing and dressing plushes; a black on mixed woollen and silk goods; a black for felt hats; a topping for vat-blue linen; a black finish with ox-blood on mixed woollen and cotton goods; a nacarat and a claret on wool.

White-lead is recommended, in preference to chalk, for adulterating oil-colours for pigment-styles.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of waste or refuse animal or nitrogenous matters for the purpose of producing fertilising substances or artificial manures. William Crookes, F.R.S., Mornington Road, Regent's Park, Middlesex. August 23, 1873.—No. 2790. The object of this invention is to convert waste or refuse nitrogenous matters into artificial manures or fertilising substances. The animal or nitrogenous matters to which the invention is applicable consist of animal matters, such as woollen rags, wool-waste, &c.; wet putrescible matters, such as fish, either fresh or stale, or such as is unfit for food, and liquid or semi-liquid matters not so nitrogenous as the before-mentioned substances.

Improved means or method of treating and clarifying impure or waste water from fulling-mills, scouring-mills or scouring processes, dye-houses, sewage, or other impure waters. Rupert Goodall, machinery agent, Armley, Leeds. August 23.—No. 2791. To the water to be clarified is added fine ashes and slacked lime, and the whole is stirred until the water is "cracked;" then add sesqui-persulphate of iron in solution (obtained from the mother liquor of copperas beds) and saturated solution of sulphate of magnesia or Epsom salts, and the whole is again stirred or agitated, whereon the solid matters and impurities and discolourations are separated and precipitated. The above chemicals are used in the proportions and manner specified.

A new process for the production of soda and potash from their respective haloid salts by the direct wet method. Charles Denton Abel, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Hector de Grousilliers and George Siemens, Berlin). August 28, 1873.—No. 2838. This invention consists in producing soda and potash from their haloid salts by admixture therewith of carbonate of ammonia dissolved in strong alcohol or wood-spirit. The salt is introduced, together with a solution of mono-carbonate of ammonia in alcohol, into a closed vessel lined with lead, which is heated, whereupon the compound will be transformed into alkaline carbonate, and chloride of ammonium, of which the former is precipitated, while the latter is retained in solution. The solution is then drawn off, and the alkaline carbonate is washed with spirit, and dried. For manufacturing on a large scale, the salt is placed in a vessel with perforated double bottom, and a heated solution of carbonate of ammonia in alcohol is then forced through the salt until no more chloride of ammonium is found in the solution issuing from the vessel.

Improvements in the recovery of alkali from the liquid in which esparto, wood, straw, or other material has been boiled. David Adam Fyfe and William Hadfield Bowers, Manchester. September 1, 1873.—No. 2873. The inventors absorb waste alkaline liquors with sawdust or other vegetable substances. The sawdust in then dried, and placed in or fed into a retort. The acid, tar, gas, and other products are collected, and the alkali is recovered from the charcoal or from the ash resulting from the combustion of the charcoal.

Improvements in the method of, and apparatus for, separating free sulphur from substances containing it. Samuel Henry Johnson, manufacturing chemist, Lea Bank Works. Warton Road, Stratford, Essex. September 2, 1873.—No. 2891. This Provisional Specification describes the separation of free sulphur from other substances by the use of bisulphide or any simple solvent; also an extractor provided with a filter.

An improved mode of separating and obtaining gold, silver, and other metals from their ores. George Haseltine, L.L.D., Southampton Buildings, London. (A communication from Soloman William Kirk, chemist, Philadelphia, and William Robert Griffith, New York). September 3, 1873.—No. 2904. The invention consists in the process of amalgamating and reducing sulphuretted ores, containing gold or silver, or other metals, *in vacuo*; and also in the method or process of reclaiming and condensing the vapourised mercury and sulphur, *in vacuo*, in their separate elementary parts again.

Improvements in apparatus for the manufacture of sulphate of soda and sulphate of potash. William Hunt, manufacturing chemist, Castleford, near Normanton, York. September 8, 1873.—No. 2944. In making sulphate of soda and sulphate of potash by introducing into chambers, containing chloride of sodium and chloride of potassium respectively, a mixture of sulphurous acid gas, atmospheric air, and steam, the chambers employed and other parts of the apparatus are made of cast-iron. This invention consists in making the said chambers of brick, clay or other cement being used in place of mortar, the space between the exterior of the brick chambers and the wall enclosing them being filled with powdered chloride of sodium or common salt rammed or pressed therein. By the consolidation of the said chloride of sodium, an air-tight packing is formed between the chambers and the outer wall, which packing is unacted upon by the hydrochloric acid gas evolved. The powdered chloride of sodium may be mixed with clay or sand, or sulphate of soda or baryta, or burnt clay may be employed in place of chloride of sodium.

An improved process for treating copper pyrites, copper blendes, and other sulphuretted copper ores which contain iron. Joseph Anthony Dixon, writer, Glasgow, N.B. (A communication from Thomas Henry Cobley, chemist, Turin, Italy). September 11, 1873.—No. 2981. The features of novelty constituting this invention are—First, the process for treating copper pyrites, copper blendes, and other sulphuretted copper ores containing iron; secondly, the employment of calcium hydrate or lime in reducing copper ores poor in sulphur.

Improved combinations of ingredients for producing explosives for blasting and mining purposes. William Blanch Brain, mining engineer, St. Annals, Cinderford, Gloucester. September 11, 1873.—No. 2984. This consists in combining in certain proportions nitroglycerin, chlorate of potash, sugar, charcoal, ground coal, sawdust, dextrin, starch, and sumach, so as to form highly concentrated explosive bodies.

NOTES AND QUERIES.

Metallic Solutions.—Would any of your readers be kind enough to inform me if there is a market for a "strong solution of zinc and iron," a solution of "tin and iron," and precipitated oxide of zinc?—Arthur T. Becks.

Egg Albumen.—Can you tell me of anyone who makes egg albumen in England? I am told that there is no maker of it in this country, which seems unlikely. If there are none in England, where is it made?—William E. A. Axon.

Ash of Plants.—Can you tell me of any work in which I shall find analyses of the ashes, and percentage of ash, of the different plants, &c. (clover, wheat, turnips, mangel wurzel, &c.), principally cultivated in this country?—H. B. Yardley.

Filtration on the Large Scale.—Will some of your readers kindly tell me how to filter, on a large scale, a black lake (logwood and iron), which will not settle so as to be washed by decantation, and is not drainable by the methods usually employed for filtering?—E. B. M.

Lime Crucibles.—Can you kindly inform me where crucibles of lime can be procured, such as those described in chemical works as used in fusing Pt before the oxyhydrogen blowpipe, but I require them on a much smaller scale than they are probably used commercially?—Delta.

Flies.—Will you please to tell in your next number if you know of anything that will keep flies off hams when they are hanging in grocer's shops, as the maggots cause a great loss to the trade every year; it must be something that will not make the hams taste, or they will be spoiled?—John Murray.

MEETINGS FOR THE WEEK.

Monday, June 15.—Royal Geographical, 8.30.
—— Zoological, 8.30.
Tuesday, 16.—Anthropological Inst., 8.
Wednesday, 17.—Meteorological, 7.
Thursday, 18.—Royal, 8.30.
—— Chemical, 8.
—— Philosophical Club, 6.

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THE CHEMICAL NEWS.

Vol. XXIX. No. 760.

THE SUCCESSOR OF STEAM.

By Dr. H. BEINS.

For many years I have, with the collaboration of my brother, J. F. Beins, Director of the Netherlands Soda Manufactory at Amsterdam, considered the question—How to transform heat into mechanical power more advantageously than it is done in our common steam and other engines. It occurred to us to make an experiment to see what degree the tension of the carbonic acid given off by natrium-bicarbonate would amount to, when heated in a closed space. We were surprised and much satisfied to find, that when natrium-bicarbonate (or the corresponding salt of kalium) in a dry pulverised state or in a watery solution is heated in a closed space, a part of the carbonic acid is given off and condensed in a not heated portion of that space, so that at a temperature of 300° to 400° C. liquid carbonic acid can be distilled out of those salts with a tension of from 50 to 60 atmospheres. I have had the satisfaction to show this experiment to several scientific men in this country (Holland), who have taken the greatest interest in the matter.

The said fact is of the greatest importance, for the following reasons:—(1). Carbonic acid of high tension (in particular liquid carbonic acid, which I have called, for the sake of convenience, carboleum) is a very remarkable body physically. By the simple method above mentioned, it can be obtained easily and in any quantity. I call attention here to the anomaly with respect to Boyle's law and the remarkable properties of liquid and solid carbonic acid, which until now have been so incompletely studied.

(2). The chemical relations of bodies under high pressures begin nowadays to be studied. For these inquiries a simple compressing apparatus is of great importance. Of course, for lower tensions than 50 to 60 atmospheres the temperature need not be raised to 300° to 400° C., but a lower degree suffices. With a saturated solution of natrium-bicarbonate heated in a boiling bath of concentrated solution of common salt, I obtained carbonic acid of 3 to 5 atmospheres. Other experiments showed that the tension increases regularly with the temperature.

(3). Compressed carbonic acid is much required for manufacturing mineral waters and other beverages.

(4). The compressed state of this gas is a condition of great importance for its application in technical chemistry.

(5). Carbonic acid of high tension, in particular carboleum, is an excellent motive power for small and great industries. This is already remarked by the discoverer of liquid carbonic acid, Faraday, subsequently by Thilorier and others, who were, unfortunately, not acquainted with the knowledge of the law of conservation of energy, which is indispensable to judge these sort of questions.

In this last case, the cost of the carbonic acid appears to be of greater importance than in the four before-mentioned modes of application. But this is principally not the case. A method, however, discovered by us for obtaining carbonic acid very cheaply is at present applied in manufacturing natrium-bicarbonate in a factory, established by us, where the salt can be obtained for manufacturers, and from which a cheap carbonic acid can be procured.

One litre of carboleum of 15° C. and a tension of 50 atmospheres weighs approximatively 0·8 kilogrm., and can produce 400 litres of carbonic acid gas of the ordinary atmospherical tension. Suppose, now, these 400 litres compressed to 50 atmospheres. The work required for that compression is represented in every case (however much may be the anomaly with regard to Boyle's law) by a mathematical figure of the same area as the hyperbolical plane, that represents the power for compressing an equal volume of air to 50 atmospheres, and this amounts to about 17,000 kilogrammetres. Per horse-power and per hour (270,000 kilogrammetres) is thus required about 16 litres carboleum of 50 atmospheres and 15° C.

Here and in the following I take, for greater simplicity, even numbers.

Only when a carboleum engine works with great intermissions can the heat of vaporation required be taken from the sides of the reservoir without artificial heating. In the majority of cases, however, the carboleum must be evaporated by the artificial heating of small quantities at a time. The heat required per horse-power hourly (270,000 kilogrammetres) amounts at least to 640 calories (0·1 kilogr. of coal). But now the objection may be made, the quantity of carboleum required for an engine of greater dimensions and continuously working is too considerable, and therefore the reservoirs must be made too heavy. And for this reason carboleum would not be applicable otherwise than for small engines working with intermissions. The fact is that greater carboleum engines must work with regeneration. They must have a store of natrium-bicarbonate and of carboleum, so that the decomposed bicarbonate is regenerated again by the carbonic acid that has worked in the engine. Such an engine transforms very advantageously the heat (furnished by the fire for decomposing the continually regenerated bicarbonate) in mechanical work. Supposing the gas working with a temperature of 100° C., the 16 litres of carboleum required hourly per horse-power are reduced to 10 litres. Such an engine requires about 0·3 kgrm. of coal per horse-power hourly, whilst the best steam-engine requires 1·2 to 0·9 kgr.

As regards the use of carboleum-engines for ships, the weight of such an engine, for instance, of 100 horse-power and combustible stores for 240 hours, may be calculated to be one-fifth less than the weight of a steam-engine of the same power. And, as many parts of the carboleum engine must be more massive, it will require less space.

Since the working of a carboleum-engine without regeneration depends on a neighbouring carboleum-manufactory, generally the engines with regeneration are to be preferred for small factories as well as for great ones. Cheap carbonic acid is therefore no essential condition for the applicability of my method for the production of motive power.

Carboleum is without danger, since it does not contain any cause of explosion, and moreover, it is for various reasons preferable to use reservoirs consisting of smaller compartments. A too abundant accumulation of the gas in the engine-rooms, so that it renders the air irrespirable, can easily be prevented. When water is not present, the metallic parts of the engine remain unaltered by the carbonic acid.

I have experimentally found that a carboleum-engine is easily constructed. Taps and joints can be made to answer perfectly. A year ago I filled a tube of hammered copper with carbonic acid of 50 atm., and not the least loss is as yet observed. Wrought metals are therefore not permeable for gases of that tension. Perhaps the phenomena of porosity, belonging to the common air-pump experiments, are partly caused by surface-condensation.

When, according to the law of Dulong and Petit, 0·25 is taken as the specific heat of natrium bicarbonate, and, moreover, the common physical laws are considered, everybody taking the great law of energy as their mentor, will easily grant the following assertions as founded on scientific facts.

For the great industry, the carboleum-engine can in almost every case substitute the steam-engine. For the small industry, specially for engines working with intermissions and during brief spaces of time, the property of carboleum of being always ready for work is of much importance; for instance, for printing-presses, fire-engines, street-locomotives, &c.

By this same property, and since the mechanical equivalent of electricity is very small, a carboleum-engine is a very fit and cheap source of electrical light. Such a light would come at a much less cost than the ordinary gaslight; and, considering this great advantage, the objection that we do not yet possess good electrical lamps for common use loses much of its value.

My method of compression furnishes easily the required tension for the conveyance of letters in tubes, and the modern break apparatus for railways.

Perhaps the property of carboleum of possessing a power of projection a hundred times cheaper than gunpowder can be made use of.

The fact that a carboleum-engine with a sufficient store of carboleum is independent of our atmosphere, makes it possible to construct a vessel, provided with means to sink to any depth of the sea, to rise and sink at will, to cruise about under water, and to maintain the life of the crew during that operation, to develop light, &c. The importance of this for scientific discoveries and industrial purposes is evident. For the purposes of war, also, must such a small and comparatively cheap submarine vessel place a peculiar, nay a decisive, weight in the scale in the question of our modern ironclads. Our late (Dutch) Minister of the Navy has taken great interest in a project for submarine vessels elaborated and proposed by me, and ordered an inquiry into it. The Commission appointed, after having examined the project, agreed with me regarding the main points. For reasons independent of the project itself, the Government has as yet not resolved upon the immediate execution of the project.

Freezing machines working by evaporation of carboleum produce ice at a much less cost than any existing freezing apparatus.

Regarding this general usefulness of carbonic acid, it is important to call attention to the fact that an inexhaustible store of carboleum is at our disposition in common chalk, for this mineral contains carbonic acid to the amount of half its weight; it can therefore produce twice its volume of carboleum.

With these brief remarks I give up my discovery to publicity. The great trouble and expense which the inquiry has taken for many years, make it our duty to try to profit by its industrial importance. Therefore I have patented the invention in several countries. But, since the extensiveness of the application widely surpasses my knowledge and my power, I invite anybody who takes an interest in the matter to aid me in applying to practical purposes my method of compression of carbonic acid. I will readily communicate my experience of the several special applications.

Groningen (The Netherlands),
May 1, 1874.

NOTE ON THE ACTION OF LIGHT UPON NITRIC ACID.

By W. H. ASTON PEAKE.

Pure nitric acid, when exposed to light, for any length of time, gradually turns of a yellowish green tint, and the unoccupied portion of the bottle containing it becomes filled with brown fumes.

On sealing a quantity of the acid in a flask, and exposing it to direct sunlight for three days, the action became very strongly marked, and on examination the acid was found to contain a considerable quantity of nitrous acid. I would presume, therefore, that the action is a reducing one.

NOTE ON THE

ABSORPTION-SPECTRA OF POTASSIUM AND SODIUM AT LOW TEMPERATURES.*

By H. E. ROSCOE, F.R.S., and ARTHUR SCHUSTER.

In order to obtain the absorption-spectrum afforded by the well known green-coloured potassium vapour, pieces of the clean dry metal were sealed up in glass tubes filled with hydrogen, and one of these was then placed in front of the slit of a large Steinheill's spectroscope furnished with two prisms having refracting angles of 45° and 60°. The magnifying power of the telescope was 40, and was sufficient clearly to separate the D lines with one prism. A continuous spectrum from a lime-light was used, and that portion of a tube containing the bright metallic globule of potassium was gently heated until the green vapour made its appearance. A complicated absorption-spectrum was then seen, a set of bands (α) in the red coming out first, whilst after a few moments two other groups appeared on either side of the D lines, the group β (less refrangible) being not so dark as the group γ. These bands are all shaded off towards the red, and in general appearance resemble those of the iodine spectrum. In order to assure ourselves that the bands are not caused by the presence of a trace of an oxide, tubes were prepared in which the metal was melted in hydrogen several times on successive days until no further change in the bright character of the globule could be perceived. On vapourising the metal, which had been melted down to a clean portion of the tube, the bands were seen as before, and came out even more clearly, the globule, after heating, exhibiting a bright metallic surface. An analysis of the potassium used showed that it did not contain more than 0·8 per cent of sodium, although, of course, the double line D was always plainly seen.

In order to ascertain whether an alteration in the absorption-spectrum of the metal takes place at a red heat, fragments of potassium were placed in a red-hot iron tube, through which a rapid current of pure hydrogen gas was passed, the ends of the tube being closed by glass plates. The magnificent green colour of the vapour was clearly seen at this temperature on looking through the tube at a lime-light placed at the other end. Owing, doubtless, to the greater thickness or increased pressure of the vapour, the bands seen by the previous method could not be resolved by the small spectroscope employed, the whole of the red being absorbed, whilst a broad absorption-band in the greenish yellow was seen occupying the place of the group γ.

The positions of the bands obtained by the first method were measured by means of a telescope and distant scale, and the wave-lengths obtained by an interpolation curve, for which well-known air-lines were taken as references. The following numbers give the wave-lengths of the most distinct, that is, the most refrangible edge of each band. As the measurements had to be quickly made, owing to the rapid darkening of the glass by the action of the metallic vapour, these numbers do not lay claim to very great accuracy, but fairly represent the relative positions of the band, and show that they do not always occur at regular intervals, although they are pretty regularly spread over the field, and all are shaded alike.

Bands of potassium shaded off towards red. Wave-length in tenth-metre:—

6844	α	6459	α	6311	α	5949	β	5763	γ
6762		6430		6300		5930		5745	
6710		6400		6275		5901		5732	
6666		6379		6059	β	5860	γ	5712	
6615		6357		6033		5842		5700	
6572		6350		6012		5821		5690	
6534		6331		5988		5802		5674	
6494		6322		5964		5781		5667	

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* Abstract of a Paper read before the Royal Society.

The bright potassium lines in the red and violet were not seen reversed, the intensity of the lime-light being too small at both extremes to render an observation possible.

In order to ascertain whether the vapour of sodium, which, when seen in thin layers, appears nearly colourless, exhibits similar absorption-bands, tubes containing the pure metal, which had been prepared and preserved out of contact with any hydrocarbon, were prepared, the metal being obtained free from oxide and the absorption-spectrum being observed in the manner already described. As soon as the metal began to boil, a series of bands in the blue (Na γ) made their appearance, and shortly afterwards bands in the red and yellow (Na α), stretching as far as the D lines, came out. At this period of the experiment the D lines widened, thus blotting out a series of fine bands occurring in the orange (Na β), some of which could in consequence not be mapped. All the bands of the sodium-spectrum shade off like the potassium bands towards the red.

When the vapour of sodium is examined in a red-hot iron tube, the colour of the lime-light as seen through it is a dark blue. As the sodium is swept away by the current of hydrogen passing through, the colour becomes lighter, and the transmitted rays can be analysed by the spectroscope. At first, the whole red and green and part of the blue is cut out entirely. The D lines are considerably widened, and an absorption-band is seen in the green, apparently coinciding with the double sodium line, which comes next in strength to the D lines. All the colours, therefore, seem to be shut out except part of the orange, part of the green, and the ultra blue. As the sodium vapour becomes less dense, more light passes through, and the same absorption-bands are seen as are observed in the other method. The vapour then has a slight bluish-green tint, but is nearly colourless.

The following numbers give the wave-lengths of the more refrangible edge of the sodium absorption-bands in tenth-metres obtained in the manner above described:—

6668	α	6361	α	6105	β	5999	β	4964	γ
6616		6272		6092		5150	γ	4927	
6552		6235		6071		5129		4889	
6499		6192		6051		5082		4863	
6450		6162		6035		5038		4832	
6405		6149		6016		5002		4810	

ON THE
ALLEGED EXPANSION IN VOLUME OF VARIOUS SUBSTANCES IN PASSING BY REFRIGERATION FROM THE STATE OF LIQUID FUSION TO THAT OF SOLIDIFICATION.*

By ROBERT MALLET, F.R.S., &c.

Since the time of Reaumur it has been stated, with very various degrees of evidence, that certain metals expand in volume at or near their points of consolidation from fusion. Bismuth, cast-iron, antimony, silver, copper, and gold are amongst the number, and to these has recently been added certain iron furnace-slags. Considerable physical interest attaches to this subject from the analogy of the alleged facts to the well-known one that water expands between 30° and 32° F., at which it becomes ice; and a more extended interest has been given to it quite recently by Messrs. Nasmyth and Carpenter having made the supposed facts, more especially those relative to cast-iron and to slags, the foundation of their peculiar theory of lunar volcanic action, as developed in their work "The Moon as a Planet, as a World, and a Satellite" (4to, London, 1874). There is considerable ground for believing that bismuth does expand in volume at or near consolidation; but, with respect to all the other substances supposed to do likewise, it is the object of this paper to show that the evidence is insufficient, and that, with respect to cast-iron and to the basic silicates constituting iron slags, the allegation of their expansion in volume, and therefore their greater density when molten is greater than when solid, is wholly erroneous. The determination of the specific gravity in the liquid state of a body having so high a fusing temperature as cast-iron is attended with many difficulties. By an indirect method, however, and operating upon a sufficiently large scale, the author has been enabled to make the determination with considerable accuracy. A conical vessel of wrought-iron, of about 2 feet in depth and 1·5 feet diameter of base, and with an open neck of 6 inches in diameter, being formed, was weighed accurately empty, and also when filled with water level to the brim; the weight of its contents in water, reduced to the specific gravity of distilled water at 60° F., was thus obtained. The vessel, being dried, was now filled to the brim with molten grey cast-iron, additions of molten metal being made to maintain the vessel full until it had attained its maximum temperature (yellow heat in daylight) and maximum capacity. The vessel and its contents of cast-iron when cold were weighed again, and thus the weight of the cast-iron obtained. The capacity of the vessel when at a maximum was calculated by applying to its dimensions at 60° the coefficient of linear dilatation, as given by Laplace and others, to its range of increased temperature; and the weight of distilled water held by the vessel thus expanded was calculated from the weight of its contents when the vessel and water were at 60° F., after applying some small corrections.

We have now the elements necessary for determining the specific gravity of the cast-iron which filled the vessel when in the molten state, having the absolute weights of equal volumes of distilled water at 60°, and of molten iron. The mean specific gravity of the cast-iron which filled the vessel was then determined by the usual methods. The final result is that, whereas the specific gravity of the cast-iron when cold was 7·170, it was only 6·650 when in the molten condition; cast-iron, therefore, is less dense in the molten than in the solid state. Nor does it expand in volume at the instant of consolidation, as was exclusively proved by another experiment. Two similar 10-inch spherical shells, 1·5 inches in thickness, were heated to nearly the same high temperature in an oven, one being permitted to cool empty as a measure of any permanent dilatation which both might sustain by mere heating and cooling again, a fact well known to occur.

The other shell, when at a bright red heat, was filled with molten cast-iron, and permitted to cool, its dimensions being taken by accurate instruments at intervals of thirty minutes, until it had returned to the temperature of the atmosphere (53° F.), when, after applying various corrections, rendered necessary by the somewhat complicated conditions of a spherical mass of cast-iron losing heat from its exterior, it was found that the dimensions of the shell whose interior surface was in perfect contact with that of the solid ball which filled it were, within the limit of experimental error, those of the empty shell when that also was cold (53° F.), the proof being conclusive that no expansion in volume of the contents of the shell had taken place.

It is a fact, notwithstanding what precedes, and well known to iron-founders, that certain pieces of cold cast-iron do float on molten cast-iron of the same quality, though they cannot do so through their buoyancy, as various sorts of cast-iron vary in specific gravity, at 60° F., from nearly 7·700 down to 6·300, and vary also in dilatability; that thus some cast-irons may float or sink in molten cast-iron of different qualities from themselves through buoyancy or negative buoyancy alone. But, where the cold cast-iron floats upon molten cast-iron of less specific gravity than itself, the author shows that some other force, the nature of which yet remains to be investigated, keeps it floating; this the author has provisionally called the repellent force, and has shown that its amount is, *cæteris paribus*, dependent upon the relation that subsists between the volume and "effective" surface of the floating piece. By "effective" surface is meant all such part of the immersed solid as is in a horizontal plane, or can be reduced to one. The repellent force has also relations to the difference in temperature between the solid and the molten metal on which it floats.

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* Abstract of a Paper read before the Royal Society.

The author then extends his experiments to lead, a metal known to contract greatly in solidifying, and with respect to which no suggestion that it expands at the moment of consolidation. He finds that pieces of lead having a specific gravity of 11·361, and being at 70° F., float or sink upon molten lead of the same quality, whose calculated specific gravity was 11·07, according to the relation that subsisted between the volume and the "effective" surface of the solid piece—thin pieces with large surface always floating, and *vice versa*. An explanation is offered of the true cause of the ascending and descending currents observed in very large "ladles" of liquid cast-iron, as stated by Messrs. Nasmyth and Carpenter. The facts are shown to be in accordance with those above mentioned, and, when rightly interpreted, to be at variance with the views of these authors.

Lastly, the author proceeds to examine the statements made by these authors as to the floating of lumps of solidified iron-furnace slag upon the same when in a molten state; he examines the conditions of the alleged facts, and refers to his own experiments upon the total contraction of such slags, made at Barrow Ironworks, and a full account of which he has given in his paper on "The True Nature and Origin of Volcanic Heat and Energy," printed in *Phil. Trans.*, 1873, as conclusively proving that such slags are not denser in the molten than in the solid state, and that the floating referred to is due to other causes. The author returns thanks to several persons for facilities liberally afforded him in making these experiments.

ON THE PHYSIOLOGICAL ACTION OF LIGHT.*

By JAMES DEWAR,
Lecturer on Chemistry, University of Edinburgh,
and JOHN G. M'KENDRICK, M.D.,
Demonstrator of Practical Physiology, University of Edinburgh.

(Continued from page 258).

II.

Since the date of the first communication, we have endeavoured to obtain quantitative results, involving time as a variable element in the case of the action of light on the retina and optic nerve. We have, therefore, found it necessary to construct a true graphical representation of the variations of the electro-motive force occasioned by the impact and cessation of light. It is clear that to register minute galvanometrical alterations, the only plan that could be employed would be to photograph on a sensitive surface, covering a cylinder rapidly revolving on a horizontal axis, the alteration of position of the spot of light reflected from the mirror, just as continuous magnetic observations are registered. As the apparatus required to execute these observations is very complicated, and would require much preliminary practice, we have in the meantime adopted a simpler method of registration. This plan is to note the position of the galvanometer at equal intervals of time, before, during, and after the impact of light on the eye. In these observations we have used a seconds pendulum giving a loud beat. One observer reads aloud the galvanometer; the other marks every interval of two and a-half seconds, registers the numbers obtained, and regulates the supply of light. A little practice in the method above described has enabled us to obtain very satisfactory results, agreeing very closely in different observations, and showing in a decided way the salient points of the variation curve.

These curves show that on the impact of light there is a sudden increase of the electro-motive force; during the continuance of light it falls to a minimum value, and on the withdrawal of light, there is what we term an *inductive effect*, that is to say, a sudden increase of the electro-motive force which enables the nerve to acquire its normal energy. The falling off of the electro-motive force by the continued action of light, is the physical representative of what, in physiological language, is called fatigue; the inductive effect exhibiting the return of the structure to its normal state. Occasionally the impact of light is not followed by a rise in the electro-motive force, but by a diminution. This is probably to be explained by the fact, that the death of the retina and nerve is indicated by a gradual falling of the electro-motive force, and that this change frequently goes on so rapidly that the impact of light is unable to produce any rise. In these circumstances, the spot of light, which before the impact of light was slowly moving downwards, is on the impact steadied for a moment, and then pursues its downward course more rapidly.

We have carried out since last communication, several distinct sets of observations:—

1. We have proved that though there is no difficulty in obtaining a strong current from the skin of the frog, this current is not affected by light. This observation demonstrates that the pigment cells of the skin in the vicinity of the cornea have nothing to do with the results obtained.

2. The current obtained from a mass of the pigment cells of the choroid, does not exhibit any sensitiveness of light.

3. The subcutaneous injection into the frog of woorara, santonin, belladonna, and calabar bean, does not destroy the sensibility of the retina to light.

4. As to the action of the anterior portion of the eye. On carefully bisecting an eye of a frog, so as to remove completely the anterior portion, including cornea, aqueous humour, iris, ciliary-muscle, and lens, and on bringing the retina into actual contact with one of the clay pads, we readily obtained a large deflection, which was as sensitive to light as when the whole eye was employed, thus eliminating any possibility of the contraction of the iris under the stimulus of light having to do with the results previously obtained.

5. On using the anterior portion of the eye, so that the cornea and posterior surface of the crystalline lens were the poles, we obtained a large deflection, which was, however, insensible to light.

6. The sclerotic and nerve without the retina, in the same manner, gave a large natural electro-motive force, also not sensitive.

7. The distribution of the electro-motive force between the different portions of the eye and cross section of the nerve may be stated as follows: The most positive structure is the cornea, then the sclerotic, then the longitudinal surface of the nerve; the cornea is also positive to the posterior surface of the crystalline lens, and the retina itself seems to be positive to the transverse section of the nerve.

8. As to the effects produced by lights of different intensities. If a candle is placed at a distance of one foot from the eye, and then is removed ten feet, the amount of light received by the eye is exactly one-hundredth part of what is got at a distance of one foot, whereas the electro-motive force, instead of being altered in the same proportion, is only reduced to one-third. Repeated experiments made with the eye in different positions has conclusively shown that a quantity of light one hundred times in excess of another quantity, only modifies the electro-motive force to the extent of increasing it three times as much, certainly not more.

9. It was apparent to us that these experiments would ultimately bear upon the theory of sense-perception as connected with vision. It is now generally admitted that no image, as such, of an external object, is conveyed to the sensorium, but that in reality the brain receives certain impressions of alterations taking place in the receiving organ. The natural query then arises,—are the physical

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* Read before the Royal Society of Edinburgh.

effects we have described and measured really comparable in any way with our sensational differences in light perception, when we eliminate all mental processes of association, &c., and leave only preception of difference of intensity? In other words, are these changes the representative of what is conveyed to the sensorium? It would appear, at first sight, that this problem is altogether beyond experimental inquiry. There is, however, a way of arriving at very accurate measures of the variation of our sensational differences in the case of light, and this has been developed theoretically and experimentally by the justly renowned physiologist Fechner. Stating the law of Fechner* generally, we may say, the difference of our sensations is proportional to the logarithm of the quotient of the respective luminous intensities. A recent series of experiments by Dalbœuf† has entirely confirmed the truth of this law. If, therefore, the observed differences in electro-motive power, registered under conditions of varying luminous intensity, agree with this law of Fechner, regulating our sensational impressions, then there can be little doubt these variations are the cause of, and are comparable to, our perception of sensational differences. Now, we have stated above, that with a quantity of light 100 times in excess of another quantity, the electro-motive force only becomes three times greater. According to Fechner's law, we may say the difference of our sensations, with that variation in the amount of luminous intensity, would be represented by 2, the logarithm of 100. Our experimental results being as 3 to 1, the difference is also 2, thus agreeing very closely. It is to be remembered, however, that these results have been obtained by experiment on the eye of the frog, but similar changes have been observed in the eyes of mammals. In the latter, however, the amount of alteration is not so great, in all probability owing to the rapid death of the parts.

10. When one clay point is placed in contact with the cornea or nerve, and the other with the section of the optic lobe, a current is at once obtained which is sensitive to light. In this experiment the eye is left in the orbit, and the nerve is uninjured. Thus, the effect of light on the retina has been traced into the brain.

(To be continued.)

ON THE

INTERVENTION OF ATMOSPHERIC NITROGEN IN VEGETATION.

By P. P. DEHERAIN.

If we determine the quantity of nitrogen contained in the manure placed upon a plot of arable land, and then find the amount of the same element present in the crop developed under its influence, we find that the manure cannot account for the nitrogen of the crop, the latter being greater. This fact has been established by Boussingault as regards the cultivated soils of Alsace, and confirmed by Hervé Mangon in case of the irrigated lands of Provence. Nevertheless, the soil thus treated does not become exhausted of nitrogenous matters. We find, in fields dunged with this manure, which would seem insufficient, a notable quantity of combined nitrogen, which goes on increasing as long as the system of cultivation is prolonged. How does the atmospheric nitrogen act? What is the mechanism of its fixation?

The author's first experiments aimed at finding reactions which might cause this fixation. He supposed that this change was produced in the soil along with the slow combustion of vegetable detritus of all kinds, by a phenomenon analogous to what ensues when a mixture of atmospheric air and of hydrogen is detonated, and a trace of nitric acid appears along with the water produced. He therefore sought to detect a diminution in the volume of nitrogen introduced into tubes along with organic matter, sealed up and heated.

The results obtained by the aid of mixtures of glucose and ammonia, glucose and potassa, and ulmic matters, were not constant, but the successes were too frequent, and the amount of gaseous nitrogen which disappeared too great, to be the result of any mistake or accident. The original procedure was gradually improved, so as to render the chances of error fewer and less important, and a successful experiment in the month of July last showed that the results announced were exact, but that the interpretation first put upon them required to be abandoned.

The following was the procedure employed in the first series of experiments:—An ordinary combustion-tube of the capacity of 60 to 80 c.c. was closed at one end, and a small glass bulb was introduced containing the substance to be analysed. The tube was then drawn out at the open end, allowed to cool, and then rapidly sealed up. At that moment it contained a quantity of gas equal to the interior capacity of the combustion-tube, *minus* the exterior volume of the bulb. In July last, at the termination of an experiment of this kind, in which 47·5 c.c. of air had been allowed to react upon a mixture of glucose and ammonia, 21 c.c. of nitrogen only were found. Out of the original 38 c.c. of nitrogen, 17 c.c. had, therefore, disappeared. In another experiment, perfectly analogous, 33·6 c.c. of nitrogen contained in the tube at the outset were reduced to 20 c.c., 13·6 c.c. having disappeared. In the former case, 42·5 c.c. of oxygen would be requisite to form nitric acid with the 17 c.c. of nitrogen absorbed. In the second, 34 would be required. The quantities present in the two cases were, respectively, 9·5 c.c. and 8·4 c.c. only. Furhermore, in a great number of experiments the author found that carbonic acid was generated. Hence, it is easy to see that not nitric acid, but another azotised compound, must be generated in the tube. On heating the tube to a higher temperature than that employed at first, the results were no better. The presence of cyanogen compounds was never detected in the results of the experiments, whence the conclusion was drawn that the nitrogenous body formed must be ammonia. On decomposing glucose or ulmic acid in presence of an alkali, hydrogen had, therefore, probably been liberated, and this nascent hydrogen, combining with the nitrogen, formed ammonia, which finally united with the carbonaceous matters to form one of the nitrogenous compounds discovered by P. Thenard.

The idea that ammonia might be formed in the soil by the reaction of hydrogen upon atmospheric nitrogen is not novel. It has been, in particular, put forward by Mulder in his "Chimie Appliquée à la Physiologie;" but not having been supported by sufficient proofs, it did not meet with acceptance, and was absolutely rejected by Messrs. Lawes, Gilbert, and Pugh in their great memoir inserted in the *Philosophical Transactions* for 1861.

The foregoing experiments showed that this formation of ammonia took place in reactions more rapid, but at the same time more energetic than those produced in the soil. The author sought next to ascertain whether ammonia could be produced at ordinary temperatures, and under the influence of such matters as the soil might be expected to contain. It is plain, from the experiments above described, that the disappearance of gaseous nitrogen must be but slight, since even when alkalies were used and higher temperatures applied, only a few cubic centimetres were ordinarily found to disappear. A more rigorously exact procedure was, therefore, needful. The following method was therefore adopted:—A known volume of air was measured over mercury, the pressure and the temperature being noted. Into this air the substances destined to act upon the nitrogen were next introduced, such as humus from old wood, sawdust, decomposed wood, glucose mixed with lime, potash, soda, ammonia, &c. The whole was then exposed to ordinary temperatures, or to a heat not exceeding 35°. After the lapse of eight to fifteen days, the carbonic acid in the mixture was absorbed by means of potassa, the oxygen by pyrogallic acid, and the residual nitrogen was transferred to a narrow tube, where the tenths of a cubic centimetre could easily be read off. The original volume of nitrogen reduced to the temperature of 0° and the pressure of 760 m.m., was then compared with the residual volume, and the increase or decrease noted.

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* Fechner, *Elemente des Psychophysik.* Helmholtz, *Optique physiologique.*

† Recent Memoir to Belgian Academy.

This mode of operation presents an irregularity. It always happens, when a solid body is introduced into the receiver containing the measured gases, that a small amount of air is introduced at the same time. This is disengaged under the influence of the diminished pressure to which it is subject during the course of the experiment. It will, however, be perceived that this error tends to augment the proportion of nitrogen contained in the receiver and to mask its fixation, and not, on the contrary, to simulate an absorption which does not really take place. The author has given, in the *Annales des Sciences Naturelles*, a long series of observations made by this method. Many of the results are negative; others, on the contrary, prove distinctly that, during the slow combustion of ulmic matters or of hydrates of carbon, gaseous nitrogen disappears. Wood and humus gave especially distinct results, the amount of nitrogen absorbed ranging from 2 to 10 c.c.

In one of these experiments, a result was obtained which led to a third mode of operating, preferable to the foregoing. In the gas receiver there remained not a trace of oxygen, and 21·8 c.c. of carbonic acid had been formed for 100 c.c. of air originally present, whilst 2·8 c.c. of nitrogen had disappeared. From this result, the inference was drawn that it was not the combustion produced by the atmospheric oxygen which favours the disengagement of hydrogen and the formation of ammonia, but that a more complete combustion must be obtained, during which carbonic acid is formed at the expense of the elements of the body itself, in consequence of what Berthelot happily calls "internal combustion."

The most successful experiments were those in which the atmospheric oxygen had completely disappeared. Hence the idea was suggested that such oxygen was possibly not merely useless, but even opposed to the production of the phenomenon which was being studied. If, in fact, the hydrogen at the moment of its liberation from an organic compound, is able to combine with nitrogen, we cannot doubt that it must be equally, and even more, able to unite with oxygen, so as to form water.

To submit this hypothesis to experimental verification, the observations made at common temperatures were provisionally laid aside, and an attempt was made to produce directly a nitrogenous compound by passing a current of pure nitrogen into a mixture of glucose and an alkali, both free from nitrogen, and gently heated to facilitate the reaction. The operation was completely successful.

On evaporating the black matter thus obtained, and determining its nitrogen, this element was always found in notable proportions. Thus 10 grms. of glucose employed yielded 0·071 grm. of fixed nitrogen, or 7·1 grms. per kilo. In another experiment, made with glucose, soda, and pure nitrogen, the result was 6·5 grms. of combined nitrogen per kilo. If atmospheric air was used instead of pure nitrogen, the amount fixed fell as low as 1·5 grms.

The experiments at ordinary temperatures were then resumed, pure nitrogen being placed over mercury instead of atmospheric air. The purity of the gas employed was always ascertained previously, and the temperature was the same as that of the air of the laboratory. Almost all the experiments were successful; out of twenty-one, two only gave negative results. The nineteen others showed absorptions ranging from 0·5 c.c. to 5·9 c.c. with a mixture of glucose and soda; sawdust and lime absorbed from 1 to 1·7 c.c. of nitrogen. The results of all these experiments may be thus stated:—

(1). Atmospheric nitrogen is capable, at such temperatures as may naturally occur in the soil, of becoming fixed in carbonaceous principles analogous to those naturally produced in the soil by the decomposition of vegetable matter.

(2). The presence of oxygen impedes the manifestation of this phenomenon, which is much more distinct with pure nitrogen than with common air.

These facts appear to have an important bearing upon agricultural practice. P. Thenard has long ago clearly recognised that there exist in the soil two distinct atmospheres, the one reducing and the other oxidising. It is in the reducing atmosphere that the fixation of nitrogen is accomplished, favoured by the mass of carbonaceous matter accumulated during cultivation. The part played by the carbonaceous matter contained in farm-yard manure and in green crops, often ploughed in with so much advantage, appears to me to be twofold. These matters, whilst decomposing, not merely yield the hydrogen needful for the fixation of the nitrogen, but, by taking possession of the oxygen confined in the soil, they favour the formation of an atmosphere poor in oxygen, in which the fixation of nitrogen and the formation of the black matters studied by P. Thenard take place.

NOTICES OF BOOKS.

Water Analysis: a Practical Treatise on the Examination of Potable Water. By J. Alfred Wanklyn and Ernest Theophron Chapman. Third Edition, entirely re-written by J. A. Wanklyn. London: Trübner and Co.

The appearance of a third edition of this manual is a proof at once of the sustained interest felt in sanitary science, and of the confidence felt in the ammonia process, which has rendered the analysis of water as to its effects on public health practicable and trustworthy. The work has been re-arranged and considerably enlarged. The chapter describing the determination of free and "albumenoid" ammonia has been greatly improved. The requisite apparatus, the preparation of the reagents, and the performance of every step of the process are concisely but clearly described. As an important addition, we note the instructions for effecting an analysis upon so small a quantity as 100 c.c. of water, the Nesslerising being brought to within one thousandth of a milligrm. In these cases the colouration is to be examined in the meniscus of the liquid.

Attention is particularly drawn to the presence of poisonous metals in water—a point too little regarded by the generality of analysts, though far from unlikely both in manufacturing districts and in the waters obtained from mountain ranges. We have felt bound to enter our protest against the absence of any special prohibition of chromium in the "recommendations" of the Rivers' Pollution Commissioners. We are happy to find that Mr. Wanklyn shares our views on the possibility of chromium compounds finding their way into drinking waters, and that he gives instructions for their detection. We quite agree with him that before any water is selected for the supply of a town its freedom from lead, copper, chrome, barium, arsenic, &c., should be most carefully ascertained. We have no evidence that traces of these metals can be eliminated by filtration.

The following passage is very interesting in view of the contradictory statements made by eminent chemists on the distribution of iodine:—"The existence of traces of iodates in natural waters deserves to be referred to, inasmuch as conflicting reports as to the finding of iodine in certain waters owe their origin to neglect of this possibility. Some experiments recently made in my laboratory have impressed me very strongly with the easy oxidisableness of iodide of potassium; and in a fully aërated water, I should now be surprised to find iodide of potassium, which I should expect to find oxidised into either iodate or periodate. Bromides and chlorides are not so easily oxidised, but even these salts may undergo oxidation."

The chapters on "Gases and Vapours Dissolved by Water," and on "Urine and Sewage" are useful additions. Attention is called to the fact that most samples of sewage are poorer both in ammonia and in other compounds of nitrogen than a calculation based upon population, average excretions, and known water supply would indicate. The author considers it "by no means impossible that the ureal fermentation is attended with the loss of nitrogen in the form of nitrogen gas."

In the chapter on "Analysis of Total Solids" it is pointed out that certain waters contain some one greatly predominating constituent. Thus the water supply of London yields residues in which carbonate of lime predominates. "These waters are, in fact, very dilute solutions of carbonate of lime (held in solution by carbonic acid)." In stating results, and in classifying waters, such fundamental facts ought, the author maintains, to be brought into due prominence. "Abstraction being made of the carbonate of lime, drinking waters, as a rule, do not exhibit very great variation in the solids contained by them." This idea points to a classification of waters calculated to throw great light both on their domestic and their industrial value.

We need scarcely add that this book is essential to every chemist whose duties may, by any possibility, include the examination of water.

CORRESPONDENCE.

CHEMICAL APPOINTMENTS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxix., p. 250, "A. Z." very evidently feels annoyed at his advertising twice for a situation and receiving no reply. For my part, advertising is the last "trick" I should try; in saying this I am sure I speak the sentiments of hundreds of qualified chemists, for to what good does it tend? If every chemist were to advertise, and all to receive answers, how many dozen of situations would be vacant each day in the year? As a rule, hasty idlers, or rather applicants, are passed by commercial men in favour of many answers to their own advertisements. The choice of one person "shoving" his abilities before the chemical world is no choice at all; folks wanting a chemist would never look near such. The supply of chemists is greatly in excess of the demand—in the proportion of about 7 to 1. "A. Z." and others ought to "bide their time" like the rest of us, and not try to find a royal road to a vacancy, for to such no royal road exists.—I am, &c.,

CHEMIST.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 20, 1874.

Action of Pure Hydrogen upon Nitrate of Silver.—M. H. Pellet.—The author finds that the conflicting results obtained by Houzeau, Regnault, and Russel may be traced to the neutrality of the salt of silver. If the nitrate is perfectly neutral, and if the gas is washed in soda, there is no action upon nitrate of silver at common temperatures. At 80° a slight yellowish grey precipitate is formed at the commencement of the experiment. The results are the same if the solution of the nitrate is slightly acid. An alkaline nitrate is reduced at common temperatures in proportion to its alkalinity. Elevation of temperature accelerates the action. Hydrogen has no action upon an acid solution either hot or cold. Nitrite of silver cannot exist in presence of nitric acid, especially if heated.

Researches on Soluble Phosphates used in Agriculture.—A. Millot.—The author investigates the phenomenon known as "reduction," or "going back." The reduced phosphate is generally admitted to be a bicalcic phosphate, due to several distinct reactions:—(1) Action of the free phosphoric acid upon the unattacked tricalcic phosphate. (2) Action of phosphoric acid upon carbonate of lime which has escaped the attack of the sulphuric acid. (3) Splitting up of acid phosphate of lime during drying into bicalcic phosphate and free phosphoric acid.—The first of these reactions has been studied by Piccard and Joulie with accordant results. Kolbe, however, announces that at common temperatures phosphoric acid produces only monocalcic phosphate, even in presence of an excess of the tricalcic salt. The author's results agreed with those of Piccard, a crystalline bicalcic phosphate being produced. This salt is, therefore, only formed when the sulphuric acid is deficient, and when there is no longer any free phosphoric acid. Carbonate of lime is never found in dry superphosphates. The author has never been able to trace the splitting-up of acid phosphate of lime in presence of a little free phosphoric acid, which is the case in all commercial phosphates. He believes that where a sufficiency of sulphuric acid has been used, "reduction" does not occur except where phosphates of sesquioxides—iron, aluminium, or manganese—are present. In the superphosphates of commerce, except sulphuric acid has been employed in great excess, the soluble lime just suffices for its saturation. The phosphoric acid is, therefore, probably in a free state. The use of alcohol at 80 per cent has been proposed for separating the free phosphoric acid from the acid phosphate of lime. The results obtained are not exact, because the acid phosphate of lime is partially decomposed by alcohol, with formation of free phosphoric acid.

Direct Determination of the Degree of Intensity of Explosive Mixtures.—M. Chabrier.—The author employs, in the examination of gunpowders, papers coloured with the iodide of starch, and glued down by their margins upon plates of glass of the same size. Upon such a paper is arranged a circle uniformly covered with the powder. The layer ought to be equal; the grains juxtaposed, and not superposed. The weight employed is about 0·5 gramme. The powder is then ignited, and the traces left by its combustion are examined. These traces vary with the nature and condition of the powder examined, but are constant with powders of the same kind, ground in the same manner.

Action of Bromine upon the Bibromo-Succinic Acid—Edm. Bourgoin.—When bromine is allowed to act upon bibromo-succinic acid at a temperature close upon 100°, and in the presence of water, the following products are simultaneously obtained:—Tribromo-succinic acid, bibromo-maleic acid, and tetrabromated hydride of ethylen.

Alcohols Contained in the Sour Waters of Starch-Works and in the Products of the Butyric Fermentation of Glucose.—G. Bouchardat.—These sour waters contain ordinary alcohol and normal propylic alcohol, yielding, on oxidation, propionic and butylic alcohols. Isopropylic alcohol is not present. The proportion of propionic alcohol is more than one-third of the whole quantity. This alcohol seems to be without action on polarised light. The alcoholic products formed during the butyric fermentation of glucose present the same properties as the former.

Determination of Alcohol in Water, Wines, and Saccharine Liquids.—M. Salleron.—A "reclamation of priority" with reference to the memoir of Duclaux on the application of capillarity to the determination of alcohol. The author proposes to distil a portion of the wine, and to take the weight of 20 drops of the distillate.

General Method for Converting the Alcohols into Nitric Ethers.—P. Champion.—For the methylic and ethylic alcohols, a mixture of sulphuric acid and alcohol at 95 per cent is gradually introduced into nitric acid (2 parts of ordinary sulphuric acid to 1 of nitric acid at 48° B. [?]). Butylic, amylic, and caprylic alcohols require 1 part of nitric acid to 3 of sulphuric acid. Alcohols which form insoluble compounds with nitric acid—such as the cetylic, cerylic, and melissic—are first dissolved in ether, which is then evaporated off at a low temperature. They are then rubbed with sulphuric acid so as to form a homogeneous paste, which is then introduced into the nitro-sulphuric acid. The method is applicable to the industrial preparation of nitro-glycerin. 1 part of glycerin at 30° B. is mixed with common sulphuric acid, taking care that the heat of the liquid shall not rise above 50° C. After it has cooled, the liquid is poured into a small excess of nitro-sulphuric acid. The mixture is effected gradually.

On Phenyl-Allyl.—B. Radziszewski.—An examination of the products obtained on treating with bromine, at temperatures ranging from 140° to 150° C., the aromatic hydrocarbides, especially phenyl-propyl.

On Pyrogallol in Presence of Salts of Iron.—E. Jacquemin.—This paper is noticed elsewhere in the Chemical News.

Colouring Matter of Wines.—The author points out means of distinguishing the colouring matter of wine from three substances frequently employed in the falsification of wines—mauve, cochineal, and *Phytolacca decandra*. Under the influence of oxygen, mauve becomes more and more soluble in water. With the colouring matter of wine, the reverse is the case. Cochineal is best detected by means of the spectroscope. Its absorption-bands are quite different from those of wine. The colour of *Phytolacca* is discharged by nascent hydrogen almost instantaneously, whilst pure wine resists for a considerable time; but, if a little tincture of *Phytolacca* is added to a red wine, it communicates its own instability to the colour of the wine, and the mixture is decolourised ten times more rapidly than if the *Phytolacca* had not been added.

Volatile Acids of Wines.—E. Duclaux.—Wines when sound contain acetic acid in slight amount, mixed with about $\frac{1}{18}$th or $\frac{1}{12}$th part of butyric acid. Valerianic acid is found in quantities not exceeding 10 milligrms. per litre, and a higher fatty acid in almost infinitesimal proportions. When wine is affected with the disease known as "*tourné*" or "*pousse*," acetic and metacetic acids are developed in about equal proportions, and to the amount of 2·5 or 2·6 grms. per litre. In the disease of bitterness, acetic acid is developed, along with butyric acid and traces of higher fatty acids. The amount of butyric acid formed is larger than in alcoholic fermentation. The author intends to investigate the disease of "acescence on a future occasion.

April 27, 1874.

Refrigerating Mixtures.—M. Berthelot.—The thermal effect produced when ice is mixed with bihydrated crystallised sulphuric acid is the sum of three effects, viz., the fusion of the acid and that of the ice, which absorb heat, and the combination of the two liquids, which liberates heat. The numbers obtained in practice are under those calculated from theory, owing to loss through radiation. The author shows from theory that no method of cooling is comparable to vaporisation, and he thinks that much higher temperatures may yet be had by means of it.

Note on the Decomposition of the Work of Forces.—M. Ledieu.—The author specifies the following distinct cases:—(1) Comparison of the work of any force whatever relative to total movement of a material point, with the sum of the works of this same force relative, respectively, to partial movements arising out of a decomposition of the total movement, where the force may be considered as one of the arbitrary components of the resultant of all the actions applied to the point. (2) Comparison of work of the only force capable of producing the total movement of a material point, with the sum of the works of the only distinct force capable of producing respectively the partial movement arising from decomposition of the total. (3) Extension of the two preceding comparisons to cases were the whole of the points of a material system are considered. (4) Comparison of the work of a resultant force relative to movement of a material point along a given trajectory, with the sum of the works of the components. The last alone is dealt with, the author says, in Treatises on Mechanics. He enquires as to the conditions of equality, in cases 1, 2, and 3, between the work relative to compounded motion, and the sum of the works relative to the component motions.

The Production of Gum in Fruit Trees Considered as a Pathological Phenomenon.—M. Prillieux.—The flow of gum is, according to the author, a real disease, which he names *gommose*. The alimentary substances, placed in reserve in the interior tissues, instead of promoting the plant's growth, are diverted to production of gum, and a portion accumulate, awaiting the instant of their transformation about gummy centres, which seem to act as centres of irritation. The case is analogous to what occurs when an insect deposits one of its eggs in the tissues of a plant, leading to production of a gall, which consists of new cells holding a mass of nutritive matter (particularly fecula) destined, not for the wants of the plants itself, but for the development of the small parasite which appears. The production of gum at expense of the nutritive matter has no other limit than the complete exhaustion of the plant. Scarification of the bark is the best remedy. M. Prillieux's explanation is this:—To cure the disease the materials misappropriated to formation of gum must be brought back to their normal destination. Hence a more powerful attraction for them must be introduced than that of the gummy centres. Now the wounds of the bark necessitate the production of new tissues, and under this strong excitation the reserve matters are employed in formation of new cells, and cease to be attracted in the wrong direction.

Orbit of the Double Star γ of Virgo.—M. Flammarion.—These two suns present the very rare case of a system revolving in a plane precisely perpendicular to our visual ray, so that there is no deformation of the ellipse through perspective owing to our arbitrary position in space. Further, the eccentricity of the double ellipse (which the author constructs) is one of the greatest known, being 0·8715. M. Flammarion estimates the period of revolution at 175 years.

Conclusions to be drawn from Applications of Thermo-chemical Theories to Explosive Substances, especially Gunpowder.—M. Castan.—The author concludes, *inter alia*, that the calorimeter does not serve well for classifying powders, the action of which depends greatly on conditions of use; that we can foresee the limit of growth of artillery power only in the conditions of ballistics, and the service of *matériel*; and that true progress in composition of powder consists, not in introduction of substances containing more work than nitrate of potash, but in application of those which liberate more of it in their formation.

Thermal Conductivity in Rocks and Substances in General.—M. Jannetaz.—The author, after referring to an observation by De Senarmont, which is in discrepance with his own, describes some experiments with a number of rocks of schistous texture. He always found unequal conductivity in different directions, and he considers that the law regulating the propagation of heat in crystals is only a particular case of one which is general, viz., that heat is propagated more easily along the surfaces, planes, or lines between which there is weakest cohesion. Various non-schistous rocks and minerals always gave a circle, not an ellipse. M. Fizeau made some remarks connecting the phenomena with those of unequal dilatation in cool-hammered metals.

New Method for Rendering Ships Insubmersible.—MM. Crouzet and Colombat.—At the water line, the hull should be divided by a bridge preventing penetration of the air from the lower to the upper division. If a hole be made in the bottom the water will rush in, but will not entirely fill the compartment, for the air, finding no outlet, will be compressed, and will equilibrate the exterior force. From this point the ship will cease to sink, it will be in the condition of a diving bell.

Elements and Ephemerides of the Planet (127).—M. Renan.

Elementary Law of Electro-dynamic Actions.—M. Moutier. (Extract.)—In his memoir the author starts with considerations enunciated by Ampère and seeks to formulate them from a mechanical point of view, regarding electricity as the result of a vibratory movements of ether.

Observations on Prof. Tyndall's Experiments on the Acoustical Transparence and Opacity of the Atmosphere.—M. Baudrimont.—The author doubts Tyndall's explanation, till better proof be had. One cannot well see how, in calm weather, there should arise sheets or simple vertical columns of air charged very differently with moisture. It is rather horizontal layers than vertical that we should expect to find differing in moisture. Nor does the theory explain sufficiently how layers containing variable quantities of moisture should only be produced at a certain distance from the shore, forming a vertical wall, which gives echoes. The velocity of sound varying with the density of the air, and becoming greater as this diminishes in approaching the surface of the water, a sound-wave going out inclined from above downwards will not move in a straight line, but a curve, which at length becomes horizontal. It is thus deformed and soon extinguished. Sound is due not merely to *evasive* waves going out from its origin, and owing their existence to a propulsion, but requires the concurrence of *invasive* waves produced by the opposite movement of the vibrating substance. When the evasive waves are become horizontal, the invasive waves cannot coincide with them beyond that place, and the sound is consequently extinguished. The vertical layer, to which echoes are attributed, is probably caused by currents, such as are met with in the Straits of Dover; these carrying along masses of air which may differ greatly in temperature, moisture, and density from those they meet in a particular locality. At Bordeaux, when the temperature of the Continent differs considerably from that of the ocean, one observes daily variations of temperature, which are due to masses of air carried along by the water of the river, the course of which changes completely four times every day.

Studies on the Properties of Explosive Substances.—M. Abel. Second memoir (extract).—This is chiefly an examination of the conditions determining detonation of explosive substances, and the circumstances and results which accompany the transmission of the detonation.

Employment of Oxygen Mixed with Atmospheric Air for Respiration.—M. Gaudin.—The author says he obtained results analogous to those of M. Crocé Spinelli's and Sivel long ago, in 1832, when a young doctor directed him to make cholera patients breathe oxygen, and some of them were saved thus. It was proposed by M. Touzet to form an establishment for such treatment as preservative against cholera, but the cholera disappeared and the idea was dropped. The author thinks that divers, coral fishers, &c., might be enabled to remain much longer under water by breathing highly oxygenated air.

Luminous Meteors.—M. Denza presented the programme of the Italian Association for observation of falling stars from April, 1874, to April, 1875. A large number of individuals, distributed in nineteen different towns, have agreed to make observations five times in the month, but only three hours at a time, viz., from 9 p.m. to midnight, or from midnight to 3 a.m. More than 1000 observations have been made during the past year, and a large number of new showers discovered.

Reimann's Farber Zeitung, No. 12, 1874.

Ungumming Silk.—For every pound of silk to be treated ¼ lb. of soap is dissolved in water, and heated to a boil. The silk is then entered, and worked in the bath for twenty minutes. It is then taken out and placed in a fresh bath containing 3 ozs. of soap to the pound of silk. In this it is placed for twenty minutes, turned round several times, rinsed, and is then ready for dyeing.

There are then receipts for a brown, a black and a rose on silks, the latter produced with saffranin, and cleared with acetic acid.

There is a receipt for a dark blue on cloth—logwood topped with methyl-violet; for a yellow on plush; for a brown on mixed cotton and woollen garments, and for a black on the same material. Next follow receipts for printing a black, brown, bismarck, ponceau, and scarlet on woollen yarns; and for dyeing an orange and a light sea-green on cotton yarns.

No. 13, 1874.

This number contains receipts for a green, a purple, a nacarat, a light and a dark drab on woollen reps.

Purple and Ponceau Mordant.—Dissolve 14 lbs. tin crystals, and 24 lbs. crystallised bichloride of tin in 50 lbs. of hydrochloric acid free from iron, and use the clear.

Then follow receipts for a green and a silver-grey on tweeds, the latter colour being produced with the well-known ink made by extracting logwood, and adding chromate of potash and borax. There are also directions for a Nicholson blue and a ponceau on silk; a peach-wood red, a magenta, three shades of prussian blue, and a light chamois and a chrome yellow on cotton yarn; instructions for finishing silks, and for preparing catechu. The catechu is to be melted at a steam heat, and kept in that state for an hour. It is then poured off from the dregs into a clean pan, mixed with three quarters of its weight of powdered bichromate of potash, kept melted for half an hour, and is then ready for use.

Next follow instructions for weighting—in plain English adulterating—raw silk with mineral matter.

Liebig's Annalen der Chemie und Pharmacie.
April 15, 1874.

A Condensation-Product of Glyoxal.—Hugo Schiff.—By dissolving glyoxal in 5 or 6 volumes of concentrated acetic acid, passing a current of hydrochloric acid gas through the solution for fifteen minutes, and allowing it to remain for some time in a warm place in closed vessels, a substance is obtained which, when dry, closely resembles potato-starch. The author has given it the name hexaglyoxal-hydrate.

Improved Air-Bath for Heating Sealed Tubes.—J. Habermann.—Unintelligible without the accompanying illustration.

Products of the Oxidation of Amylum and Paramylum by means of Bromine, Water, and Silver Oxide.—J. Habermann.—By the action of bromine and water upon the carbo-hydrates, and subsequent treatment with oxide of silver, amylum, like dextrin, yields dextronic acid. Paramylum, similarly treated, yields an acid isomeric, but not identical, with dextronic acid. Gluconic was found to be capable of crystallisation—a point hitherto disputed.

Soda in the Ashes of Plants.—G. Bunge.—The author examines the opinion that soda is not an essential constituent of plants. This view is supported by the experimental cultivation of plants in solutions supposed to be free from salts of soda, by the qualitative experiments of Peligot on the ashes of a great number of plants, both wild and cultivated, and by his quantitative examination of the ash of the kidney-bean (*Phaseolus Vulgaris*), in which no soda was found after the potash had been removed by means of platinic chloride. The author points out a source of error in Peligot's method. The latter chemist determined the alkalies merely in the aqueous extract of the ash. But in some ashes a small part only of the soda dissolves in water, the larger portion forming insoluble double salts with the phosphates of the alkaline earths, and can only be fully determined in a nitric or hydrochloric extract of the ash. A much smaller proportion of potash escapes detection in this manner. The author adopted the following method for the determination of the alkalies:—The aqueous extract of the ash, in a platinum capsule, is mixed with so much baryta-water that a scum appears on the surface of the liquid after stirring. The mixture is heated and filtered whilst hot, covering the funnel with a watch-glass. The filtrate is then placed in a platinum capsule, treated with a current of carbonic acid to throw down the excess of baryta, heated, filtered, the filtrate evaporated down in a platinum capsule, the residue slightly ignited, taken up in a little water, filtered through a small filter, and the filtrate evaporated to dryness with hydrochloric acid in a small platinum capsule. The alkaline chlorides are ignited and weighed, and separated by means of chloride of platinum. The nitric or hydrochloric solution of the ash is evaporated to dryness in a platinum capsule, the residue re-dissolved with a few drops of nitric or hydrochloric acid and water, mixed with baryta-water as above, and filtered while hot. Ammonia and carbonate of ammonia are added to the filtrate to throw down the lime and baryta, the liquid is filtered, and the filtrate evaporated to dryness in a platinum capsule. The ammoniacal salts are cautiously driven off at the lowest possible heat. As the solution thus treated still retains a trace of carbonates of the alkaline earths, the residue is re-dissolved in water, evaporated down with oxalic acid, heated till all frothing ceases, again dissolved in a little water, filtered, evaporated in a small platinum capsule, ignited, and dissolved in a little water. In case the solution is not clear, it is again passed through a small filter, and the filtrate evaporated down with hydrochloric acid. The alkaline chlorides are ignited, weighed, and then separated by means of chloride of platinum. The author succeeded in finding a very small amount of soda in the soluble part of the ash of the kidney-bean, and a somewhat larger amount in the insoluble part. He detected and determined in like manner soda in the ash of clover, of meadow hay, of strawberries, and of apples.

Oxysulpho-benzid, and Certain of its New Derivatives.—Dr. J. Annaheim.—A very lengthy paper, not suited for abstraction.

Normal Hexylen and Certain of its Derivatives.—Otto Hecht and Julius Strauss.—The author, after reviewing previous researches on hexylen, concludes that the hexylens from mannite, and from petroleum-hexyl-chloride, as also their parallel derivatives, are not isomeric but identical.

MISCELLANEOUS.

Royal Society.—At the meeting on the 4th inst., the following gentlemen were elected Fellows of the Society:—Isaac Lowthian Bell, F.C.S.; W. T. Blanford, F.G.S.; Henry Bowman Brady, F.L.S.; Thomas Lauder Brunton, M.D., Sc.D.; Professor W. Kingdon Clifford, M.A.; Augustus Wollaston Franks, M.A.; Professor Olaus Henrici, Ph.D.; Prescott G. Hewett, F.R.C.S.; John Eliot Howard, F.L.S.; Sir Henry Sumner Maine, LL.D.; Edmund James Mills, D.Sc.; Rev. Stephen Joseph Perry, F.R.A.S.; Henry Wyldbore Rumsey, M.D.; Alfred R. C. Selwyn, F.G.S.; Charles William Wilson, Major R.E.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès, Schaerbeek, Brussels). September 13, 1873.—No. 3013. To procure the carbonates of baryta and strontia, alkaline earthy chlorides are dissolved in water to 12 or 15 degrees Baumé, and the solution, whether of the chloride of barium or the chloride of strontium, is mixed with hydrate of magnesia in a vessel, which is afterwards closed. The mixture is kept in continual agitation, and subjected to the action of a current of carbonic acid, which, being absorbed by the magnesia, forms a carbonate of this base, and, by the employment of an excess of carbonic acid, the decomposition is rapidly effected, and the alkaline earths produced free from carbonate of magnesia. In practice, the treatment of the alkaline earthy chlorides by magnesia and carbonic acid is effected in two operations; in the first, the magnesia is in excess, which gives, when the reaction is terminated, a liquor containing exclusively chloride of magnesium, which is decanted, and a precipitate obtained, consisting of a carbonate of the alkaline earth and the magnesia employed in excess in a carbonated state, which excess is neutralised in the second operation by an additional quantity of the alkaline earthy chloride. The liquor containing the chloride of magnesium is concentrated by evaporation, and the hydrated chloride of magnesium submitted to the action of steam, superheated to about 300° C., without pressure, so that it becomes completely decomposed, and is in the condition to be rapidly hydrated and carbonated. To manufacture caustic baryta and strontia from their carbonates, the carbonate is mixed with carbon or chalk, and the mixture, whether subjected or not to the action of superheated steam, is heated in a regenerating or reverberatory furnace.

Improvements in the treatment of the liquors used in scouring or cleaning wool. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, Middlesex. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès Schaerbeek, Brussels). September 13, 1873.—No. 3014. The object of this invention is—First, to extract the potash in a state of carbonate, which is its most valuable condition, by a process which is at once economical and expeditious; and, secondly, to completely extract the greasy matters which separate from the washing-liquors. The process consists in the employment either of caustic baryta or strontia, the essential characters of which are—First, to effect the entire separation of the greasy matter; secondly, to extract the carbonate of potash contained in the washing-liquors; and, thirdly, to effect the continuous revivification of the baryta and strontia employed.

The process of manufacturing coffeetina. Walter Penn Francis and Francis Addiscott, coffeetina manufacturers, Webber Street, Blackfriars Road, Surrey. September 16, 1873.—No. 3031. Coffeetina is an article of food used either as a substitute for coffee or as an admixture, and is prepared from the stone of the tamarind by extracting the stone or bean from the fruit or pulp, roasting it in cylinders, and grinding it. It then assumes the character of coffee, the novelty of which constitutes the invention.

An improved compound or mixture to be used for lubricating purposes, and for the grinding and reducing of white-lead and colours. George Frederick Cornelius, operative chemist, Merton Abbey, Surrey. September 16, 1873.—No. 3036. The improved compound or mixture consists of milk from cows or other animals in combination with animal or vegetable oils or fatty matters.

Improvements in rendering wood uninflammable, applicable to building and other purposes. Rev. Thomas Jones, St. Austell, Cornwall. September 16, 1873.—No. 3037. The invention consists in rendering wood for building and other purposes uninflammable by impregnating it, by pressure or otherwise with a solution or composition of tungstate of soda in water, and then painting it or not, according as it is to be exposed to the weather or not. By these means the wood is rendered harder by the process, and, the inventor considers, is also less liable to decay.

Improvements in the manufacture and treatment of beer in order to preserve it and to restore it when it has become sour. Alexander William Gillman and Samuel Spencer, Castle Brewery, Saint George's Road, Southwark. September 17, 1873.—No. 3056. For the purposes of this invention, the inventors employ a soluble salt of sulphurous acid, particularly the sulphite of potassium, sodium, ammonium, or calcium, in combination with a chloride or other soluble salt of calcium, or the precipitated oxide of calcium, or the carbonate of potassium, sodium, and ammonium, in the manufacture and treatment of beer, in order to preserve it, and to restore it when it has become sour.

Improvements in the manufacture of fertilising substances and in apparatus therefor, and in the means for preventing the escape of offensive odours during such manufacture and from slaughter-houses, rendering-tanks, and the like. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Jacob J. Storer, Boston, Massachusetts, U.S.A.). September 18, 1873.—No. 3070. This invention relates to improvements in the manufacture of fertilising substances, and in deodorising cylinders and processes, to be employed in treating blood and animal offal for such manufacture, and in treating the blood, offal, and other refuse of slaughtering, packing, rendering, and similar establishments, so that all offence may be avoided.

Improvements in the treatment of phosphates of iron and alumina for the purpose of obtaining certain useful products therefrom. Peter Spence, manufacturing chemist, Manchester. September 18, 1873.—

No. 3071. This invention consists in treating phosphates of iron and alumina for obtaining phosphate of lime and caustic soda.

A new blue dye or colouring matter. Charles Denton Abel, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Robert Gottheil, civil engineer and chemist, Berlin). September 19, 1873.—No. 3080. According to this invention, the oils distilled from tar are neutralised by an alkali, washed, and again distilled. The oils containing carbolic acid, creosote, or naphthaline are treated with weak lye to remove the carbolic acid or creosote, and are then combined with strong caustic lye, and subjected to oxidation. By this means, a dye-stuff or colouring matter is produced, which, after separation by filtration and washing, is dissolved in an acid, filtered, and again precipitated by the addition of potash, soda, or ammonia, and freed from any residuary oil by alcohol. The dye thus produced furnishes a blue colour, insoluble in alkalies, ammonia, soap, or alcohol, but soluble in dilute acids.

Improvements in the manufacture of alkali. Henry Deacon, Appleton House, Widnes, Lancaster. September 20, 1873.—No. 3092. This invention relates to the "finishing" of the "salts" obtained in the manufacture of alkali. At present these "salts" are "finished" by being calcined in reverberatory furnaces. Now this invention consists in causing heated air to pass through the said "salts" when at an elevated temperature.

Improvements in extracting and recovering the oils, resins, and colouring matters of manufactured or waste fabrics, or from the raw materials of cotton, linen, wool, silk, or other similar substances, and in utilising the same. George Mackay, Edinburgh. September 25, 1873.—No. 3129. The feature of novelty which constitutes this invention is the extraction and recovery of oils, resins, and colouring matters from fabrics or fibres by boiling with an alkali, after which the foreign matter is allowed to settle, the liquid drawn off, the oils and colouring matters utilised by acid, and the precipitate washed and mixed with ochre or other matter to form a paint, and with salt of lead to form a varnish, these being dissolved in a suitable solvent, or the precipitate with saponified alkali and colouring matter may form printing-ink.

Certain modifications and improvements in coating iron and steel with certain metals, with special application to coppering or covering iron ships with an adherent and protective coating of a less oxidable metal; and, in general, coating large or small pieces of iron and steel, and particularly iron ships, with copper; and in apparatus for that purpose. Frederic Weil, engineer, and Farnham Maxwell Lyte, chemist, Paris. September 25, 1873.—No. 3136. The features of novelty of this present invention consist—First. In the application of an alkaline battery, whether used in wells or by means of any other form of porous jars or vessels placed in contact with, or immersed in, a metallising alkalino-organic bath. Secondly. In the preparation of the iron to be metallised by means of an acid bath followed by an alkalino-organic bath. If desirable, we dispense with the acid bath or the alkalino-organic bath or both, or substitute for one or the other of these a simply organic and non-alkaline bath made with glycerin or other organic material or an organic salt, neutral alkaline, or acid, even an alkaline non-organic bath applied hot if required before the acid bath. Thirdly. The coppering of ships by means of our process described. Fourthly. The metallising any large or small pieces of ironwork by the process above specified. Fifthly. The particular form or forms of apparatus we have described in the illustration of our improved process as applied to iron ships.

A new liquid polish for cleansing and brightening painted, varnished, glazed, and metallic surfaces. Jean François Chevalier, Lyons, France. September 26, 1873.—No. 3137. This invention relates to a liquid polish compounded of water, hydrochloric acid, alumino-calcareous matter, and ivory-black, applicable for removing tarnish and producing a brilliancy on painted, varnished, glazed, and metallic surfaces.

Improvements in the purification of sugar, molasses, and saccharine juices, and in the regeneration of part of the substances employed, and also in the preparation of manure from the residues thereof. Jean Marie Onésime Tamin, M.D., Chancery Lane, Middlesex. September 26, 1873.—No. 3151. The invention consists in a process of purifying sugar, molasses, and saccharine juices by the use of soluble metallic silico-fluorides. Also in a method of utilising the whole residuum of the said purification in producing a new manure. Also in a process of regenerating the primitive silico-fluoride used in the above purification, and in the utilisation as manure of the part remaining after the said regeneration.

NOTES AND QUERIES.

Adulteration of Oils.—I should esteem it a favour if you or any of the readers of the Chemical News can inform me of any decisive colour-test by which 5 to 10 per cent of bleached cotton-seed oil can be detected in lard oil. I do not think so small a percentage would have much effect on the colour or specific gravity of lard oil, still it would, in a commercial point of view, be of importance, as it might enable the falsifier of the oil to undersell the producer of the genuine oil.—Cheiron.

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THE CHEMICAL NEWS.

VOL. XXIX. No. 761.

ON THE PHYSIOLOGICAL ACTION OF LIGHT.*

By JAMES DEWAR,
Lecturer on Chemistry, University of Edinburgh,
and JOHN G. M'KENDRICK, M.D.,
Demonstrator of Practical Physiology, University of Edinburgh.

(Concluded from page 271).

III.

SINCE the date of our last communication, we have continued our investigations, with the following results:—

1. The light from a beam of uncondensed moonlight, though of weak intensity, and almost entirely free from heat rays, is still sufficient to alter the electro-motive force of the nerve and retina.

2. We have examined the phenomenon in the eyes of the following animals:—

(1.) The common newt—*Triton aquaticus*; (2.) The goldfish—*Cyprinus auratus*; (3.) The rockling—*Motella vulgaris*; (4.) The stickleback—*Gasterosteus trachurus*; (5.) The common edible crab—*Cancer pagurus*; (6.) The swiming crab—*Portunus puber*; (7.) The spider crab—*Hyas coarctatus*; (8.) The hermit crab—*Pagurus Bernhardus*; and (9.) The lobster—*Homarus vulgaris*.

The general results with the eyes of these various animals were similar to those we have previously described. The eye of the goldfish and rockling, both sluggish fishes, were found to resemble each other, inasmuch as the variations in the electro-motive force were slow, and in this respect they presented a marked contrast to those of the active and alert stickleback, the eye of which was very sensitive to light.

The experiments on the eyes of crustacea are of importance, because they show that the action of light on the compound eye is the same as on the simple eye, namely, that it alters the amount of the electro-motive force of the sensitive surface. The eye of the lobster was found to give a deflection of about 600 galvanometrical degrees, the scale being placed at a distance of about twenty-six inches. Light produced a variation in this deflection of about 60 degrees,—that is, about 10 per cent, the largest amount of variation we have yet observed in any eye. It was also demonstrated that the effect of light, diminished in intensity by distance, was exactly what was observed in the case of the simple eye. For example, at the distance of one foot, a variation to the extent of about 100 degrees was observed. At a distance of ten feet, with 1-100th part of the amount of light, the effect was not one degree, but 20 degrees, or one-fifth of the total amount observed at one foot.

3. The action of light on the electro-motive force of the living eye in cats and birds (pigeon and owl) has been observed. In our earlier experiments, we found great difficulty in observing sensitiveness to light in the eyes of mammals and birds, when these were removed with the utmost despatch from the orbit of the animal immediately after death. This was evidently owing to the fact, that the sensibility of the nervous system in these animals disappears quickly after the withdrawal of healthy blood. It, therefore, became necessary to perform the experiment on the living animal. This was done by first putting the cat or bird under the influence of chloroform, then fixing it by a proper apparatus so that the head was perfectly immoveable, and lastly removing the outer wall of the orbit with as little disturbance to the ciliary vessels as possible. The optic nerve was now cut, the transverse section directed upwards, and the clay points of the electrodes were now adjusted, one to the transverse section of the nerve, and the other to the cornea. With these arrangements, we at once found a strong current extremely sensitive to light.

4. The effect was traced into the optic lobes of a living pigeon under chloroform. The following were the results of this observation:—*a*. When one pole was applied to the left optic lobe, and the other to the cornea of the right eye, a deflection was obtained which was sensitive to light; *b*. When the pole was removed from the right eye and applied to the cornea of the left, a smaller deflection was obtained, also sensitive to light; and *c*. When light was allowed to impinge on both eyes, while the one pole was in contact with either eye and the other with the left optic lobe, the result was nearly double that produced by the impact of light on one eye alone, either right or left. These effects may be explained by the decussation of the optic nerves in the optic commissure.

5. The eye of a snake* was examined, and in its action resemble that of the frog.

6. We are therefore now in a position to state, that the law of the variation in the electro-motive force of the retina and optic nerve, holds good in the following groups of the animal kingdom, Mammalia, Aves, Reptilia, Amphibia, Pisces, and Crustacea.

7. Many experiments have been made which prove that the psychophysical law of Fechner, alluded to in previous communications, is not dependent only on preception in the brain, but in part on the structure of the eye itself. The effects which occur on, during, and after the action of light on the retina, also take place after the eye has been removed from all connection with the brain. Thus the law of Fechner is not, as has been hitherto supposed, a function of the brain alone, but is really a function of the terminal organ, the retina.

8. We have also employed a new method of registering galvanometrical variations, which may be of service in many physical and physiological researches. This consists in placing at the proper distance from the galvanometer, instead of the ordinary graduated scale, the surface of a cylinder covered with paper, and moving on a horizontal axis by clock-work. The spot of light reflected from the galvanometer mirror is rendered more precise by having the shade of the galvanometer lamp blackened over the entire surface, with the exception of a spot about three millimetres in breadth, in the centre of which a line or cross is made of soot. The image of this line or cross is of course reflected by the mirror upon the cylinder. When the cylinder is set in motion by the clock-work, the spot of light may be accurately followed by the hand of the observer, after a little practice, with a fine brush moistened with ink. The cylinder we employed performed a complete revolution in eighty seconds. This time was divided into four equal parts, each representing twenty seconds, by four lines drawn transversely at equal intervals across the paper on the cylinder. The first space, between lines one and two, represented twenty seconds, in which the eye was in the dark, and in which the electro-motive force is represented by a straight line; the second space, between lines two and three, represented twenty seconds, during which the effect of the impact of light took place, and in which the variation of the electro-motive force is indicated, either by a curve to the right or to the left; the third space, between lines three and four, represented twenty seconds of continued action of light, during which the electro-motive force gradually rises; and lastly, the fourth space, between lines four and one (the point of starting), represented twenty seconds, during which the electro-motive forces at first rises on the withdrawal of light and afterwards sinks rapidly.

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* Read before the Royal Society of Edinburgh.

* Kindly sent us by Mr. Bartlett, of the Zoological Gardens, Regent's Park. We have also to ackowledge the kindness of Mr. Lloyd, Manager of the Crystal Palace Aquarium, who supplied us with three specimens of *Eledone* (a cuttle-fish, to represent *Mollusca*), but none arrived alive.

THE ADULTERATION ACT.

Correspondence between the Local Government Board and Mr. J. A. Wanklyn.

Our readers may be aware that some time ago a controversy took place between Dr. Redwood and Mr. Wanklyn concerning certain samples of bread, which the former of these chemists maintained were sophisticated with alum, whilst the latter declared them free from such adulteration. Dr. Redwood having cited the results obtained by Dr. Hardwicke in confirmation of his own, Mr. Wanklyn, in a letter to the *Times*, under date March 5, 1874, objected to this gentleman as a competent authority. The "attention" of the Local Government Board having been "called" to this letter they consider it inconsistent with the testimonial of competence which Mr. Wanklyn had previously given to Dr. Hardwicke, and wrote for an explanation.

Mr. Wanklyn, in reply, points out that to certify a man competent for the routine duties of a public analyst, is far from implying him able to act as a referee between two chemists of long experience and acknowledged standing. He also maintains that the "detection of small portions of alum in bread is too uncertain, too difficult, and too costly to be required of the public analyst," and doubts whether the addition of 4 grs. of alumina to a 4-lb. loaf can be fairly regarded as an adulteration.

Mr. Wanklyn's first plea we consider irresistible. To take a perfectly analogous case, every sane man will admit that a medical graduate might be perfectly qualified and fit to practise, with benefit to the public, and yet not entitled to adjudicate on a moot point between two of the heads of his profession. With Mr. Wanklyn's last contention we are unable to agree. We believe that the smallest addition of alum acts injuriously, by depriving the bread of a portion of its phosphate of potash. Still, we are aware that Mr. Wanklyn's view is no subterfuge put forward for the occasion, but a doctrine which he has consistently maintained. Under these circumstances we were even more surprised than pained to find that the Local Government Board, in a second letter, pronounce Mr. Wanklyn's explanation unsatisfactory, accuse him most gratuitously of insincerity, and finish by stating that—"they must decline to accept in future any certificate of qualification given by him with regard to appointments requiring their approval!" By way of illustrating the high value they, in turn, set upon sincerity, the Local Government Board sent a copy of their second letter to the Town-Clerk of Middlesboro' unaccompanied by the rest of the correspondence, and without any explanation! Such facts, we think, speak for themselves too forcibly to require any comment.

ANALYSIS OF JERUSALEM COPROLITES.

By H. B. YARDLEY.

The following is the analysis of coprolites reported to have been sent over from Jerusalem (the exact locality I do not know). The sample was given me already ground, and I was informed that it came over so in bags. I have not seen a sample of the *whole* coprolites, so do not know but what the large excess of sand may arise from insufficient washing. As will be seen from its analysis, it would be of little or no use as an article for the manufacture of artificial manure.

Moisture, &c.	9·41
Sulphur	2·22
*Phosphoric acid	11·05
†Carbonic acid	2·33
Sulphuric acid	3·87
Lime	13·40
Oxide of iron	4·25
Sand	53·30
	99·83

* Equal to tribasic phosphate of lime, 24·12.
† Equal to carbonate of lime, 5·29.

REMARKS ON A PAPER BY MR. E. C. C. STANFORD, ENTITLED "ON COMMERCIAL ANALYSES."

By E. F. TESCHEMACHER and J. DENHAM SMITH.

In the Chemical News, vol. xxix., pp. 190 to 193, we find inserted a paper read before the Glasgow Philosophical Society, Chemical Section, entitled "On Commercial Analyses," by E. C. C. Stanford, F.C.S., to which our attention has been directed, and which we may at once say we should not have noticed had not the author gone out of his way to remark, injuriously, on a memoir of ours which appeared some six years since in the Chemical News, and which has, to our knowledge, never been questioned, even by Messrs. Chalmers and Tatlock, whose conceptions of the importance of the City of Glasgow we then ventured to banter, and whose opinions as to the necessity of the purity of the salts of platinum used in estimating potash, we also ventured to contest.

Looking, however, more carefully at this production of Mr. Stanford's, which he has styled "On Commercial Analyses," to which he quickly betakes himself, instead of "On Commercial Analysis," the abstract question, which—however important—he has barely glanced at, yet which is the subject he intended to discourse on, we are tempted to review some statements of an author who, by his own act, has made himself fair game for us, and hence this ink-shed.

The Glasgow analysts lauded and magnified Glasgow, and our author now tells us that "the number of samples passing through the hands of the analytical chemists of Glasgow alone must be enormous; and that he "can bear strong testimony to the remarkable accuracy with which these analyses generally are performed," statements the chemical public will gladly welcome as showing a vast improvement in Glasgow during the past six years; for in 1868 Messrs. Chalmers and Tatlock were impelled to inform the same Philosophical Society—"In Glasgow, at least, an accurate and uniform method of estimating that base (potash) is of the utmost importance, as . . . unpardonable discrepancies constantly occur with regard to the results obtained by chemists of standing and experience." A subject on which, at the time, we gladly admitted these gentlemen to be fair judges, for their "experience had extended over a period of many years, during which they had conjointly made thousands of potash determinations," all of which were necessarily wrong, "since the gist and key-stone of their new process for estimating potash was the purity of the platinum used," and, as they most justly stated, that "pure platinic chloride solution is not the rule but the rare exception, false results must be alarmingly numerous." It is also true that we found ourselves compelled to demur to these alarming statements, and to point out that "true and accurate results depended on manipulation;" a statement which, despite Mr. Stanford's sneer, is the plain and hitherto unquestioned truth.

Mr. Stanford having thus re-vindicated the "remarkable accuracy" of the Glasgow analysts of the present day, proceeds to tell his readers what the analyst should do, and what he should not do; and in virtue, we must assume, of an instinct which would be of singular value to an analyst, says "I heard of a case some time ago in which samples of a cargo of coprolites guaranteed 62 to 63 per cent, were drawn and sent to four chemists, all eminent. One made the strength 56 per cent, another 57 per cent, another 58 per cent, and the other 62 per cent, the latter being right." The instinct which enables this gentleman to decide in this *ex cathedra* style, which of four analyses of coprolites is the right one fails, by the law of natural compensation, to be supplemented by the grammatical instinct, which many a less favoured man possesses, who must be sorely puzzled to determine in the paragraph above quoted the nature of the substance described in these six percentages, and how, out of four, a "latter" is possible, whether right or wrong.

As to these coprolites, there is no evidence adduced to prove whether Mr. Stanford is right or wrong. He may be right, but, *prima facie*, no analyst would expect this to be the case.

Further remarks now follow, which, were we to notice, would virtually amount to a repetition of much that has been said, till we come to the assurance that—"Some chemists still cling to the inaccurate method of simply precipitating the tribasic phosphate of lime by ammonia, and the precipitate may contain in addition, everything precipitable by ammonia; it is generally, therefore, too high." "May contain," "is generally too high," forsooth! Is not this critic chemist enough to know that "must contain" and "always too high" is the only language he can use? for, be it remembered, throughout he is speaking only of bone-ash, coprolites, and mineral phosphates. All we need say on this mode "that some chemists still cling to" is that we should have held it had not been practised for a generation or more, were it not that we note its re-appearance in the pages of the Chemical News and elsewhere from time to time, and that we have a strong suspicion—well-nigh amounting to certainty—that this antique method has been employed, not so long ago, by a professor of chemistry—no self-dubbed professor—but a professor of chemistry in a Scottish university, to determine the amount of tribasic phosphate of lime in a sample which both he and we examined with widely differing results. Nor were we surprised when our clients questioned our accuracy on the ground of our difference with an University Professor, whom we esteem as a good chemist, but found to be a sorry analyst—terms which, *pace* our author, are neither interchangeable nor synonymous. He then proceeds—"Others adopt Fresenius's process, which gives results a little too low." These "little too low results" prove to be no less than 2 per cent too low; for he further informs us that "a convocation of chemists at Magdeburg agreed that it, Fresenius's process, could be made sufficiently accurate by the addition of 0·1 to every 5 per cent of tribasic phosphate of lime found." Why is it, we may ask, that Convocations seem to be so prone to pass ridiculous and stultifying resolutions? Fancy a convocation of chemists engaged in vamping up an analytical process acknowledged to yield, not merely erroneous results, but erroneous to the extent of no less than "*two per cent.*" Our ancient friend "which some chemists still cling to" is well-nigh as accurate as this one sanctioned by convocation; whilst we maintain, that whatever may be sanctioned in Germany and approved in Glasgow, there is no analyst of repute in London who would not scout the notion of employing in his laboratory any method involving an error of 2 per cent, despite the authority of all the convocations or general assemblies that ever agreed upon silly resolutions. There is, however, "balm in Gilead," for we are glad to be able to add that the magnesian process for determining phosphoric acid is *accurate*. We by no means affirm that the original process invented by Dr. Fresenius will yield accurate results, and the inventor would doubtless be the first to deny such an assertion; but we do say that the magnesian process, worked out in detail by competent analysts, impatient of inaccuracy, and jealous of their reputation, will yield *absolutely reliable results*. The present is neither the time nor place to describe our own modification of this most excellent mode of determining phosphoric acid, but we shall be most willing to publish it in detail, should it be desired, in the Chemical News.

Mr. Stanford now quits the phosphates for a time, and devotes his attention to "potassium salts," *i.e.*, mixed salts of potash and soda; and here we are troubled to divine his meaning when speaking of what it pleases him to term "discrepancy," *i.e.*, difference in the amount of potash reported by various chemists. He adds: "It probably arises from the use of alcohol in addition to platinum chloride, whereby a portion of the soda (*sic*) salt is not unfrequently thrown down and weighed with the potassium salt."

We beg permission to condole with Mr. Tatlock on his patron, who, at the earliest opportunity, misquotes him, saying—"Mr. Tatlock introduced the use of platinum chloride solution instead of alcohol, in an excellent paper read before this Society in 1868;" whereas Messrs. James Chalmers and Robert R. Tatlock expressly say "most practised analysts digest the residue in strong aqueous solution of platinic chloride," which is both sense, and a disclaimer by these gentlemen of a discovery Mr. Stanford attributes to Mr. Tatlock.

Mr. Stanford then ventures to state—"In the paper referred to, Chalmers and Tatlock show the great importance of using perfectly pure platinum and the difficulty of obtaining it; and that ordinary spongy platinum will give a result 2 per cent too high in chloride of potassium." Hazy language this; and not hazy only, but not founded on fact, for in our "Remarks" on this paper of Messrs. Chalmers and Tatlock, in which memoir of ours *we prove, and prove by a series of experiments in detail*, that "the use of perfectly pure platinum," instead of being of "great importance" is of *no importance*, and that "ordinary spongy platinum *will not give results 2 per cent too high*."

In spite of having read our paper proving these analysts to have been mistaken in what they term "the very key-stone of their process," Mr. Stanford does not hesitate to describe this process of theirs as "the best which has yet appeared on the subject, and if the process is followed as described, I repeat from long experience, it is rigidly accurate. I speak strongly on this point because the process was afterwards criticised in the Chemical News by Teschemacher and Smith, in which they kindly attributed all the inaccuracies to the chemists of Glasgow, and all the perfect results to their own process, which involves the use of alcohol and its attendant errors." How can a process be "rigidly accurate" which is wrong in its very key-stone? And why should he "speak strongly" when this process was none of his, be it good or bad, unless impelled by the irrepressible impulse that seems to animate Glasgow chemists to uphold the infallibility of the brotherhood. As for "the inaccuracies of the Glasgow chemists," it was the inevitable inference from the statement of Messrs. Chalmers and Tatlock that "pure platinum was essential to accuracy," so that, if they were right, every analysis of potash salts anterior to the appearance of their paper in 1868, must have been wrong. Whilst, as to "the use of alcohol and its attendant errors," we are unable to comprehend how potash can be estimated by platinum *without* the use of alcohol.

Not content with the foregoing, Mr. Stanford, with a disingenuousness which brings its own punishment, says, speaking of us, "the authors convict themselves, as in one of their own experiments undertaken to test the process, they actually show an error of 1·4 per cent of a potash salt," an imputation on our accuracy—

> "That palters with us in a double sense,
> That keeps the word of promise to our ear,
> And breaks it to our hope."

This "one experiment undertaken to test the process"—or rather they, for two are quoted by us, but one suppressed by Mr. Stanford—were made not "to test the process," *i.e.*, our process, but the mistaken statement and belief of these Glasgow analysts, that ordinary spongy platinum was unfit to be employed in making solution of chloride of platinum wherewith to estimate potash, as it yielded results some "2 per cent too high," and "which could not be brought much nearer to the truth;" this they characterised "as an alarming state of things," and condemned spongy platinum as unfit for this use. Now these statements proved to be moonshine, and to pin Mr. Stanford to the point we quote the very words we made use of at the time. "We dissolved this spongy platinum just as it came from the makers, without any attempt at preliminary purification, and as this solution, when of equal strength to ours, was somewhat darker and redder, it probably was not quite so pure. This solution with 1000 grs. of No. 1 = 10 grs. of nitrate of potash, duly acidified with hydrochloric acid, yielded 24·10 grs. of the platinum salt = 9·860 of nitrate of potash, *being a loss instead of a gain, and the worst result of our tests*; whilst 1000 grs. of No. 2 solution = 8 grs. of potash salt, yielded, with this "impure" solution of platinum 19·35 grs. of platinum salt = 8·003 of potash salt, a result which should satisfy the most exacting chemist." The italics are recent. This is what our candid critic calls convicting ourselves of error. Mr. Stanford, therefore, not only perverts our statements, instead of quoting the very words employed—which is the recognised duty of a writer who impugns the alleged facts of another, and suppresses, not only the fellow experiment on the subject of spongy platinum, but also the other experimental results of our modification of the platino-potash process which prove its accuracy and reliability,—but has ventured to make the general statement against us, which we must be pardoned for repeating;—"The authors convict themselves, as in one of their own experiments, undertaken to test the process, they actually show an error of 1·4 per cent of a potash salt." Here he doubtless thought himself safe from detection; he might rely on none of his readers but ourselves taking down the Chemical News of 1868 to verify his assertion, and he almost escaped us under the cloud of his vague general statement, for we sought long before we found the place in our memoir where he has perverted the object of our experiments, which was simply to prove or disprove the assertion that ordinary spongy platinum will give a result 2 per cent too high, whereas these experiments showed in the one case a loss of 0·140 in the potash salt, and in the other a gain of 0·003 in the potash salt, which latter we again repeat "is a result which should satisfy the most exacting chemist."

We have now to complain of a second, but a very minor, offence committed by Mr. Stanford, who has thought proper, without seeking our permission, to print portions of a business letter not intended for publication, and addressed to some clients of ours with instructions to submit the same to Mr. Stanford, who had thought right, on insufficient grounds, to question the accuracy of an analysis made by us on account of these gentlemen; which letter Mr. Stanford has attributed to Mr. Teschemacher instead of to us. As he has taken this liberty, and printed such portions of the letter as he fancied would serve his purpose, we now challenge him to publish this letter *in extenso* in the Chemical News, and promise, subject to the consent of the Editor, that a note he addressed to our Mr. Teschemacher in reference to this same letter shall appear in the pages of the next number of the journal. We may now take leave of Mr. Stanford.

Before we close these remarks, we would so far trespass on the patience of our readers as to say a few words respecting the process for estimating potash which is to be found in the Chemical News, vol. xvii., pp. 244—246. The object of this paper was to point out that the conclusion arrived at by Messrs. James Chalmers and R. R. Tatlock as to the necessity of the absolute purity of the solution of platinum employed, and which they term "the key-stone of their process" was erroneous, and that "accurate results depended on manipulation." We also showed that the pulverulent condition of the double salt of platinum and potash was an ordinary source of error, and that it was requisite to obtain this double salt in the state of orange crystalline scales, which admitted of rapid and perfect edulcoration, to ensure accurate results. But, as some of our readers may not have this number of the Chemical News at hand, we recpitulate the leading and essential points of our process:—

"I. Dilution of solutions.

"II. Use of chloride of platinum in large excess, about 20 grains of metallic platinum to 10 grains of salt examined.

"III. Heating of solutions, and evaporation so conducted as to obtain the potassic salt in a crystalline scale-like condition.

"IV. Evaporation on water-bath to a pasty condition.

"V. Drenching with spirit whilst salt and dish are hot, and, instantly, on removal from water-bath.

"VI. Washing by decantation, and avoiding breaking down of the crystalline precipitate.

"In practice, the process is a rapid one from beginning to end, requiring about two hours; less time, indeed, than was frequently expended in merely washing the dense pulverulent precipitate we denounce as liable to many sources of error."

We have used this process for many years without being able to devise any improvement in it, but other analysts may have advantageously modified it; if so, we should be glad to hear from them of such improvements, with a view to their adoption in practice, and publication in a reprint of the method we are now contemplating.

London.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 18th, 1874.

Dr. Frankland, F.R.S., &c., Vice-President, in the Chair.

The names of the visitors having been announced, and minutes of the previous meeting read and confirmed, Messrs. E. Cleminshaw, J. Bayne, J. M. Glassford, W. Sharman, and T. H. Tono were formally admitted Fellows of the Society. The following names were read for the first time:—Messrs. F. W. Bayley, James Forbes, Jun., Edwin Lawson Kock, M.D., Frederick Baden Benger, and Louis Siebold. For the third time—Messrs. W. H. Wilson, Richard Apjohn, M.A., W. A. Carter, B.A., James Kilroe, Thomas Garside, James Henry Davies, George Christopher, Charles Benjamin Caswell, and F. Stocks, who were balloted for and duly elected.

The first paper, "*On the Action of Chlorine, Bromine, &c., on Isodinaphthyl,*" by W. Smith, was read by the Secretary. The author, after referring to his published account of the mode of preparation of isodinaphthyl, $C_{20}H_{14}$, by the action of heat on naphthalene, proceeded to describe the action of chlorine on it. The product, $C_{20}H_{10}Cl_4$, is an amorphous powder, soluble in alcohol and ether, but insoluble in water. The corresponding bromine compound was not obtained, the action of bromine on the isodinaphthyl giving rise to a white amorphous substance freely soluble in ether, less so in alcohol, and insoluble in water. Apparently, it is a mixture containing the compound $C_{20}H_7Br_7$. The sulphonic acid sublimes at a low temperature in slender needles, which are readily soluble in water. Its solution is fluorescent, as are also those of its salts.

Dr. Frankland, in thanking the author, remarked that this research exemplified the general law of the aggregation of atoms under the influence of heat, resulting in the production of molecules of greater density.

Dr. Wright called attention to the fact that the action of heat on naphthalene in removing two of hydrogen gave a different body from what was produced if the naphthalene was first brominated, and the bromine then removed.

Dr. Armstrong then read four "Communications from the Laboratory of the London Institution."—No. XIII., "*On Coal-Tar Cresols and some Derivatives of Para-Cresol,*" by H. E. Armstrong and C. L. Field. Commercial "cresylic acid," boiling at 190° to 205° C., was heated for about 20 hours at 100° C. with an equal weight of concentrated sulphuric acid, and the product, after removal of the excess of sulphuric acid, converted into barium salts by neutralisation with barium carbonate. An excess of barium hydrate was now added to the solution, which caused the precipitation of the basic barium salt of para-cresol-sulphonate. The filtrate was found to contain the potassium salts of phenol-parasulphonic acid, phenol-metasulphonic acid, and a cresol-sulphonic acid, from the latter of which a cresol was obtained which appeared to be pure ortho-cresol. The basic barium para-cresol-sulphonate was converted into the corresponding potassium compound, and then heated in sealed tubes to 160° C. with dilute hydrochloric acid, whereby it splits up into potassic hydric sulphate and pure para-cresol boiling at 198° to 201°. With nitric acid, para-cresol yields two nitro-cresols, one a yellow volatile oil which becomes solid at 0°, the other a crystalline solid; by the further action of nitric acid, these are converted into the dinitro-cresol melting at 83°. Nitric acid converts potassium para-cresol-sulphonate first into potassium nitro-para-cresol-sulphonate, and then into dinitro-cresol. The dibromo-nitro-cresols obtained from the volatile nitro-cresol and from the nitro-para-cresol-sulphonate appear to be isomeric. Bromine converts potassium para-cresol-sulphonate first into mono-, then into dibromo-para-cresol-sulphonate, and finally into tribromo-cresol.

" No. XIV. "*On the Action of the Chlorides of the Acids of the Sulphur Series on Organic Compounds,*" by H. E. Armstrong and W. H. Pike. The action of chlorhydric sulphate on numerous compounds has been examined by the authors, in order to ascertain what circumstances govern the three possible modes of action of this chloride.

$$(1).\quad SO_2\begin{cases}Cl\\OH\end{cases} + R'H = SO_2\begin{cases}R'\\OH\end{cases} + HCl.$$

$$(2).\quad SO_2\begin{cases}Cl\\OH\end{cases} + R'H = SO_2\begin{cases}R'\\Cl\end{cases} + OH_2.$$

$$(3).\quad SO_2\begin{cases}Cl\\OH\end{cases} + 2R'H = SO_2\begin{cases}R'\\R'\end{cases} + OH_2 + HCl.$$

It is found, for example, that when the chloride is added to well-cooled toluene, the product consists almost entirely of toluene-sulphonic acid; if the temperature is allowed to rise, less sulphonic acid is produced, and at the same time a considerable quantity of toluene-sulphonic chloride and toluene sulphone, $(C_7H_7)_2SO_2$. When, however, the toluene is added to the chloride, the proportion of the two latter products is far greater. The action of this chloride on benzene, xylene, cymene, iodo-benzene, chloro-benzene, cyano-benzene, dibromo-benzene, bromo-naphthalene, aniline, and acetanilide has also been examined by the authors. With the pyro-sulphuric chloride, the reaction may take place in the manner indicated by the equations:—

$$(1).\quad \begin{cases}SO_2Cl\\O\\SO_2Cl\end{cases} + 2R'H = 2SO_2\begin{cases}R'\\Cl\end{cases} + OH_2.$$

$$(2).\quad \begin{cases}SO_2Cl\\O\\SO_2Cl\end{cases} + 3R'H = SO_2\begin{cases}R'\\R'\end{cases} + SO_2\begin{cases}R'\\Cl\end{cases} + OH_2 + HCl.$$

$$(3).\quad \begin{cases}SO_2Cl\\O\\SO_2Cl\end{cases} + R'H = SO_2 + Cl_2 + R'SO_3H.$$

The chlorine, however, is never evolved as such, but produces chlorinated compounds; phenol, for example, yields a mixture of the two isomeric monochloro-phenols and of the two monochloro-phenol-sulphonic acids. The action of the pyrochloride on various compounds has been examined, and it is found that benzene yields all the products required by the above equations; whilst with dibromo-benzene the reaction is chiefly that represented by equation (1).

No. XV. "*On the Haloid Derivatives of the Nitro-Phenol-Sulphonic Acids,*" by H. E. Armstrong and F. D. Brown. The action of bromine on the potassium salt of iodo-nitro-phenol-sulphonic acid, previously described by the authors, gives rise to bromo-nitro-phenol-sulphonic acid, $C_6H_2Br.NO_2.OH.SO_3H$, identical with the product of the action of bromine on nitro-phenol-parasulphonic acid. Two isomeric nitro-phenol-sulphonic acids are formed by the action of sulphuric acid on the volatile nitrophenol, which yield two isomeric bromo-nitro-phenol-sulphonic acids when treated with bromine. Further bromination converts both these into the dibromo-nitro-phenol, melting at 117°, whilst nitric acid produces isomeric bromo-dinitro-phenols.

No. XVI. "*On the Decomposition of Dichloro-Nitro-Phenol (Melting at 125° C.) by Heat,*" by H. E. Armstrong and F. D. Brown. In this reaction the whole of the nitrogen is eliminated in the gaseous state as nitrogen, nitric oxide, and nitric peroxide, whilst three solid products are formed, one of which has been identified as dichloro-quinone. The formation of the latter body confirms the opinion that quinone is a para-derivative, and not an ortho compound (1 : 2) as formerly supposed.

The thanks of the Society having been communicated to the authors, Mr. E. Neison read a paper "*On the Products of the Decomposition of Castor Oil (No. III., On the Decomposition by Excess of Alkaline Hydrate).*" After referring to the discrepancies in the results hitherto obtained by the different chemists who had examined this reaction, the author said that he had made numerous experiments with varying proportions of oil and alkali, conducting the distillation at different temperatures. The results showed that octylic alcohol and methyl-hexyl-ketone are invariably produced, although the proportions in which they occur vary with the circumstances under which the reaction takes place; some octylene was also obtained, but no heptylic alcohol. By oxidation with bichromate solution the alcohol was converted into caproic acid, and is therefore methyl-hexyl-carbinol. An octylene boiling at 126° to 128° C. was also prepared from it by the action of zinc chloride, and the bromide and chloride of the olefine examined. The author purposes to carefully examine the alcohol and ketone formed in this reaction, as well as their derivatives.

The Chairman then thanked Mr. Neison for his interesting communication, in which he had so successfully elucidated the conflicting statements of chemists who had worked on this subject.

The sixth paper was on "*Hydrogen Persulphide,*" by Dr. W. Ramsay. Hofmann's compound of hydrogen persulphide with strychnine—prepared by adding a cold saturated alcoholic solution of strychnine to an alcoholic solution of ammonium persulphide,—when finely powdered and added to concentrated sulphuric acid, is decomposed, but the liberated hydrogen persulphide, being of nearly the same density as the acid, decomposes before it has time to separate, and the heat produced by diluting the acid decomposes it. The precipitate obtained on adding a solution of calcium persulphide to dilute hydrochloric acid was found, on analysis, to have a composition varying from H_2S_7 to H_2S_{10}. Hydrogen persulphide is an almost colourless oil, which cannot be distilled even under reduced pressure. Its vapour irritates the eyes, and its taste is very acrid and disagreeable. The author finds that its reducing action on organic bodies is much more powerful than that of hydrogen sulphide.

The next paper was on "*Suberone,*" by Dr. C. Schorlemmer and Mr. R. S. Dale. After noticing the investigations of this compound which have been already published, and which are somewhat discordant, the authors state that the suberone which they prepared from pure suberic acid possessed the properties ascribed to it by Tilley. On fractioning the crude product, the first portion consisted of hexane, the suberone distilling at 179° to 181° C. It has an agreeable odour, and its molecular formula is $C_7H_{12}O$. Nitric acid converts it into the next higher homologue of suberic acid, a crystalline substance, $C_7H_{12}O_4$, melting at 103° C. Its silver salt is only sparingly soluble but the barium salt dissolves readily and crystallises from its solutions in transparent tables. The calcium salt is very characteristic, being less soluble in boiling than in cold water. Although this acid has the same composition as the pimelic acid obtained by Hlasiwetz and Grabowsky from camphoric acid, its properties and those of its salts are very different; the authors propose, therefore, to call the new acid the α-pimelic.

A paper, "*On the Action of Nitrosyl Chloride on Organic Bodies; Part I., On Phenol*," by Dr. A. W. Tilden, was then read by the Secretary. In this action the phenol is oxidised to quinone, which is then converted into chlorinated quinones, the nitrosyl chloride suffering reduction not merely to nitric oxide, but being actually converted into ammonium chloride. The phenol was dissolved in about twice its weight of glacial acetic acid, and nitrosyl chloride passed in in the gaseous state. A deep purple colouration was first produced, which afterwards changed to reddish brown, whilst a crystalline matter was deposited, which, on examination, proved to be chloranil. The solution contained an amorphous nitrogenous substance, besides ammonium chloride and a small quantity of chloranil.

The Chairman having thanked the author in the name of the Society, Dr. D. Tommasi read three communications in French, the first of which was a description of "*An Apparatus for Determining the Moisture and Carbonic Anhydride in the Air*." This consists of a flask of a capacity of 8 or 10 litres, furnished with a movable cover, into which are inserted two stopcocks, a thermometer, and an oil-manometer. The apparatus is placed in a large box, and surrounded with cotton-wool; after removing the cover, a metallic cylinder containing calcium chloride or potassium hydrate is introduced, the cover replaced, and the stopcocks opened. A current of air is now passed through the apparatus, the stopcocks are closed, and in a few minutes the manometer is read off by means of a telescope, the amount of aqueous vapour or carbonic anhydride being indicated by the greater or less elevation of the column of oil.

The next paper was "*On a Method for Determining Ozone in the Presence of Chlorine and Nitric Oxide*." The apparatus employed consists of two glass tubes, furnished with stopcocks at the bottom, into each of which is introduced an equal quantity of a normal solution of potassium ferrocyanide. The tubes are closed with corks furnished with bent tubes, one of which is in connection with an aspirator, the other dipping into the solution. By this means a current of the gas to be examined can be passed through each of the solutions; in one case, however, it is previously passed through a tube containing platinum-black or manganic peroxide to decompose the ozone. On titrating the contents of each tube with potassium permanganate after the experiment, one will give the total amount of ferricyanide produced by the ozone, chlorine, &c., whilst the other merely gives the result due to the chlorine, &c., without the ozone; from these the amount of ozone can readily be calculated.

The third paper by Dr. Tommasi was "*On the Constitution of Urea*." The author thinks that neither of the formulæ—

$$\mathrm{CO}\left\{\begin{matrix}\mathrm{NH_2}\\ \mathrm{NH_2}\end{matrix}\right. ; \quad \left.\begin{matrix}\mathrm{CO''}\\ \mathrm{H_2}\\ \mathrm{H_2}\end{matrix}\right\}\mathrm{N_2}$$

generally employed can express the constitution of urea, as the 4 atoms of hydrogen are not all equally replaceable by alcoholic radicals, no compound urea being known which contains more than 2 molecules of an alcohol radical; he therefore proposes the formula—

$$\left\{\begin{matrix}\mathrm{(NH)''-H}\\ \mathrm{CO''}\\ \mathrm{(NH)''-H}\end{matrix}\right.$$

The compounds produced by the action of cyanic acid on compound ammonias the author considers to be not compound ureas, but derivatives of ammonium cyanate.

A note "*On the Restitution of Burnt Steel*," by S. L. Davies, was then read. The author finds that burnt steel can again be re-steeled or re-carbonised by dipping the red-hot metal into a mixture of resin oil with one-fourth residuum from the paraffin stills, then re-heating and cooling in the ordinary way.

"*On the Action of Earth on Organic Nitrogen*," by E. C. C. Stanford. The author, after alluding to the efficacy of charcoal in retaining the organic nitrogen of decomposing organic matter, gives details of the results of his experiments on mixtures of earth and decomposing animal matter, from which it appears that the earth is but an indifferent drier, and that the mixture continuously loses nitrogen, which is evolved principally under the form of ammonia; moreover the earth does not act as an oxidiser, and no nitrification takes place.

Dr. Frankland remarked that the action of charcoal was very different from that of dry earth; the sea-weed charcoal, when mixed with fœces or urine and allowed to dry, retaining almost the whole of the nitrogen. When decomposition of nitrogenous matter was in the direction of putrefaction, ammonia was always produced, but, at the same time, much of the nitrogen passed off in the elemental state.

The last paper was on "*Aniline and its Homologues in Coal-Tar Oils*," by Mr. W. Smith. On examining "red or anthracene oils," "creosole oils," "ordinary coal naphtha," and the black spent acid obtained in the purification of benzol, the author detected aniline in all, the latter containing an appreciable quantity. The aniline in the acid from the treatment of the heavier naphtha was purer, and the amount greater, than from the other spent acids.

This the last meeting of the session was finally adjourned at a late hour until November next.

NOTICES OF BOOKS.

The New Chemistry. By Josiah P. Cooke, Ewing Professor of Chemistry and Mineralogy in Harvard University. London: H. S. King and Co.

This work forms one volume of the so-called "International Scientific Series." On what account it has received a name so unpleasantly suggestive, and what constitutes internationality in a set of scientific books, we do not pretend to decide.

Professor Cooke's object, as he informs us in his preface, is "to give to the philosophy of the science a logical consistency by resting it on the law of Avogadro." No more striking illustration of the revolutions in scientific theory can well be imagined than that a doctrine scarcely considered twenty years ago as lying within the domain of chemistry at all, should now be put forward as its fundamental principle. It would, indeed, seem as if chemistry were now studied under the auspices of physics, and that the boundary-line of the two sciences was the favourite region for research. It is, of course, from the very nature of the human mind, impossible to present facts free from theories, generalisations, and explanations. Too often, indeed, these, if carefully examined, consist merely in giving a name to the unknown something. We are able to see through a pane of glass, and we "explain" the fact by saying that it possesses the property of transparency. An equivalent of an element unites with one equivalent only of another, and we explain this again by applying to it the word "univalent." It is by no means our author's intention to convey to his readers chemical facts further than as they may serve to illustrate the doctrines which he is upholding. But what he does attempt—to give a view of the chemical theories of the day—is ably performed. It is a work which may be safely recommended "to an intelligent, though not professional" reader, and which the professional chemist also, whether he accept its views or not, will do well to study.

Cocoa and its Manufacture, with Remarks on the Working of the Adulteration of Food Act, 1872. By J. Holm. London: G. Rivers.

This pamphlet, the substance of a paper read before the Society of Arts, will no doubt command attention during the present inquiry into the operation of the "Adulteration of Food" Act. The author gives us an interesting sketch of the culture of the cacao-tree, the preservation and preparation of its fruit, the conflicting analytical results obtained by different authorities, and the adulterations of the manufactured article. Among these he mentions animal fats, not probably of the finest kinds, chicory—that most unhappy consequence of the great continental war at the beginning of the century—catechu, and certain mineral matters, such as red lead, peroxide of iron, and sulphide of mercury. These adulterations he considers have baffled analytical chemists. The detection of catechu, lead, and mercury cannot offer any insuperable difficulty. "That the admixture of sugar and farina are adulterants" (*query*, is an adulteration) the author indignantly denies. To a certain extent this may be admitted. Still we must remember that farina is, next to woody fibre, the cheapest product of the vegetable kingdom, and of all the substances eaten by man the most insipid.

The author himself speaks elsewhere of "the addition of animal fat to cover the use of a poor cocoa, and enable the addition of an excessive quantity of sugar and farina." This is the danger of legalising declared admixtures, that the purchaser has no notion of the quantity of the inferior article which has been used. The grocer is allowed to sell mixtures of coffee and chicory. How is the public to tell whether the vile root forms 10 or 90 per cent of the mixture? Even in the latter case the seller is before the law blameless. Quite the same with cocoa. If we once sanction the presence of farina, all that is required of the maker is that he shall add cacao nuts "enough to swear to." That the "soluble cocoas" too commonly sold in England are about as appetising as a cup of bill-sticker's paste sweetened with treacle must be admitted with regret. According to the author, the reason why chocolates like those of France and Spain, which require scraping and boiling, find little favour in this country, is the national dislike of trouble. This fear of trouble is the cardinal sin of the English *cuisine*, and it plays admirably into the heads of "pushing" tradesmen, by whom we are "taken in and done for." That the present Adulteration Act is inefficient we cordially admit, and we trust that the Parliamentary Committee now sitting will be able to see the way to its amelioration.

Results of an Experimental Enquiry into the Mechanical Properties of Steel of Different Degrees of Hardness, and under various Conditions, Manufactured by Charles Aspelin, Esq., Westanfors and Fagersta Works, Sweden. By David Kirkaldy. London: Published by the Author. 1873.

In this volume we are presented with the results of an interesting investigation conducted by Mr. Kirkaldy at his Testing Works at Southwark. The steel submitted to test was made at the Fagersta Works, and was sent over as manufactured in ingots, bars, and plates, whilst the samples were further prepared under Mr. Kirkaldy's immediate direction. As the enquiry was left entirely in the hands of this gentleman, we have the best assurance that the tests were selected and applied with that judgment which his long experience would dictate. The samples when properly prepared were submitted to tensile strains, compressive strains, transverse stresses, twisting stresses, and shearing stresses. The results are carefully tabulated in forms which will be consulted with great interest by the Mechanical and Civil Engineer.

In connection with some of the questions which such enquiries suggest, we may remind the reader of a very elaborate investigation on the mechanical properties of Swedish iron and steel, conducted a few years ago by Professor Styffe of the Polytechnic School of Stockholm. His results were published in the *Jernkontorets Annaler*, and the Swedish paper was translated into English by Mr. C. P. Sandberg.

Looking at such enquiries from the standpoint of a chemist, we cannot help regretting that the samples which are submitted to these careful mechanical tests, should not also be in all cases examined chemically. It is well known that the mechanical properties of a metal are often materially affected by the presence of even a very small proportion of foreign ingredients. In the case of these Swedish steels, investigated by Mr. Kirkaldy, we know the proportion of chemically-combined carbon, because it is the custom in Sweden to classify steels according to their degrees of hardness as represented by their percentage of carbon, which is generally determined by Eggertz's colouration-test. But it would have been of great interest to carry the chemical enquiry further, and to determine at least the proportion of phosphorus and sulphur in each sample.

Daily Bulletin of Weather Reports (Signal Service United States Army); With the Synopses, Probabilities, and Facts for the month of September, 1872. Washington: Government Printing Office.

The War department of the United States has a well-organised meteorological section. Observations are made simultaneously at a number of stations thrice daily, and the results are telegraphed to Washington. Here they are recorded, collated, and forecasts, as we should call them, of the weather to be expected during the ensuing twenty-four hours are telegraphed back to the stations. The work before us contains daily tables of the barometric pressure in 72 stations, of the temperature, the humidity, the direction and velocity of the wind; the state of the clouds, upper and lower, with the direction of the upper currents of air if observed; the rainfall during the last 8 hours; and remarks on the general state of the weather. A daily chart gives a graphic representation of the same facts.

On another page we find the forecasts for the next day, and the facts showing how far the predictions issued on the previous day have been verified. A brief synopsis of the results is placed daily at the service of the public press. We need scarcely say that documents of this kind, drawn up daily with the utmost care, and published in monthly volumes, must be of incalculable service for the promotion of meteorological science. Such a collection of data affords means for tracing the action of causes supposed to influence the weather, and for verifying theories, such as no private observer could otherwise command.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—The Fellows of the Chemical Society have just received a most curious circular, signed by the Secretaries, requesting us to exert ourselves to promote the sale of our periodical, the expense of which has become so considerable since the abstracts of foreign papers have been inserted. Allow me to suggest at once a return to the old *quarterly* issue of the journal, giving nothing but the papers read before the Society. This would suit the funds of the Society much better, and would be all that the Fellows of the Chemical Society require.

The show of papers read is miserably small it is true, but if the days put aside for "lectures" were not allowed to interfere with the regular meetings, and papers of a more practical character were encouraged, not only would the number of contributors of papers be much increased, but the Society would be better able to withstand the alluring influences of the rapidly rising Chemical Section of the Society of Arts.—I am, &c.,

Equivalent.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 4, 1874.

Depth of the Magnetised Layer in a Bar of Steel.—M. Jamin.—The author conceives the bar as made up of threads, or elementary chains, formed of small magnets joined by their contrary poles. The contrary poles facing each other are concealed, so that the threads are inactive except at their extremities where there are free poles. The threads lie parallel to the axis in prismatic bars, but, as the free poles repel each other, they expand by diverging and terminate at different points of the free surface where they develope reactions. In each element of surface the intensity is proportional to the number of poles and the square of the detaching force. The total number of threads on the total quantity of magnetism is equal to the sum of the intensities for each element, that is, to the sum of the square roots of the detaching forces. There are four points to be examined:—(1) The sum total of the threads which traverse the middle zone. (2) The law of their distribution in this zone. (3) The sum total of the intensities distributed in the free surface. (4) The distribution of these intensities. The author experimented with four series of steel plates, having thicknesses of 1, 2, 3, 4, m.m. and 1 metre long, by 50 m.m. broad. He traced, parallel to the length, four equidistant lines, dividing them into 5 bands of 50 m.m. breadth, then at distances 0, 50, 100 m.m. from the extremity he measured the detaching forces of a small proof contact suspended from a balance. He concludes (in general) from his experiments that in a thick bar of steel there is no magnetisation at the centre; that the elementary threads only begin to appear at a distance of 3 or 4 m.m. from its surface, but that they are multiplied and contracted more and more in the free surface. The law of decrease of magnetic quantity agrees with the formula $\frac{F}{a^y}$, F being the intensity at the superficial point (it is $\frac{F}{a}$ at distance 1, $\frac{F}{a^2}$ at distance 2, &c.). The totality of magnetism condensed in a plate of thickness y is—

$$m = 25\left(1 - \frac{1}{(1 \cdot 6)^y}\right).$$

This quantity is *nil* for $y = 0$, increases very rapidly up to 1 and 2 m.m., very slowly thereafter. For an infinite thickness $m = 25$, hardly more than for 3 or 4 m.m.

Observations on M. Faye's Recent Note on Pouillet's Calculation of the Cooling of the Solar Mass.—M. Ledieu.—The author makes some strictures on M. Faye's conclusions.

Researches on Hydrogen (continued).—M. Favre.—The fixation of gaseous hydrogen by palladium is quite different from its fixation by platinum black. In the latter case, the hydrogen is not chemically changed; in the former it undergoes an allotropic modification before combining. The alloy of hydrogen and palladium is explosive, and when hydrogen is fixed by palladium to saturation, there is always incandescence (on contact of air) with liberation of aqueous vapour. Considering that ordinary hydrogen, in being fixed by platinum black, liberates about 20,000 calories, one may find in the thermal phenomena accompanying the condensation of this body, and combination of *active* hydrogen with palladium, the expression of the quantity of heat leading to allotropic transformation of ordinary gaseous hydrogen. We have analogous cases in the transformation of oxygen under the electric effluvia, the change of red phosphorus into ordinary phosphorus, &c.

Report on Apparatus for Transfusion of Blood, Presented to the Academy by M. Moncoq and M. Mathieu.—Question of priority.

Illumination of Opaque Bodies by Neutral or Polarised Light.—M. Lallemand.—If a bundle of polarised rays (the ordinary spectrum from a prism of spar, *e.g.*) fall on an opaque body of dull surface without reflecting power, the results got on analysing with a Nicol may be grouped in three categories, according as the opaque substance is white, coloured, or black. In the first case, the light diffused shows no sign of polarisation—whatever the incidence may have been. The diffusion is here a phenomenon of isochromatic fluorescence. The superficial molecules of the body vibrate in unison with the incident rays, and emit neutral light of the same colour and of proportional intensity. If the body be coloured, the diffused rays have no more an intensity proportional to that of the existing rays. Some of the colours are very bright, others are considerably weakened. The diffused rays are partially polarised, and some almost completely. A variable portion of the incident ray excites vibration of the superficial atoms, and develope a fluorescence generally isochromatic; another part of the ray experiences a sort of molecular reflection, constituting veritable diffusion. There is a simple propagation, in all directions, of the incident luminous movement, so that, in a determinate direction, the vibration of the ether in the diffused ray is always the projection, in a plane normal to this ray, of the incident vibratory movement. Dark bodies (as platinum black, oxide of copper, black smoke, &c.) diffuse the spectrum like coloured bodies; but the fluorescence developed by the incident rays is always isochromatic and equal for all the rays; that is, the superposition of all the rays diffused by fluorescence would re-constitute a part of the incident white light. Here the fluorescence is weak, and the truly diffused light which has retained polarisation is relatively very intense. The author considers these phenomena to confirm his theory of the illumination of transparent bodies.

Gravitation, Cohesion, and the Distance of the Centres of Molecules.—M. West (extract from memoir).—Gravitation and cohesion are manifestations of the same force. As we know the law of this, also the dilatation of a mass of nitrogen under the influence of one calorie, we may construct, in terms of the distance of the molecular centres, an expression of the quantity of work necessary to overcome the cohesion of the mass of nitrogen. Since, further, this quantity of work is a datum of experiment, we find, by putting this datum equal to the expression referred to, and solving the equation, that the distance of the molecular centres (which is the same for all gases in normal conditions of temperature and pressure) is equal to 665×10^{-9} metres. In water, at the temperature of maximum density, the distance is 62×10^{-9} metres. In all chemical equivalents of the series where the weight of the equivalent of hydrogen is 10 grms., the number of the molecules is invariably 761×10^{-15}.

Influence of Spring Heats on Phylloxera vastatrix.—M. Cornu.—The author considers the middle of April as the average date of waking of the insect in Herault, Montpellier and neighbourhood, and the Bouches-du-Rhone.

Phenomena Observed in the Satellites of Jupiter.—M. Flammarion.—The principal fact here mentioned is that the third satellite, which usually appears white like the others when crossing the planet, was seen dark, and darker than the grey band on which it appeared. It was nearly as dark as the shadow of the second satellite. This fact (noticed rarely before) the author explains by a variable atmosphere in the satellite; the brightness varying with the quantity of clouds present. When the atmosphere is clear the satellite appears dark. Secchi, again, supposes permanent spots on the satellite. In another observation, the author noticed the shadow of the second satellite, contiguous with that of the third, grey, while the latter was black on the same white background

Might not this, he asks, be due to the refractions produced by a considerable atmosphere surrounding the second satellite?

Reflecting Power of Flames.—M. Soret.—The author concludes from his experiments (made with highly concentrated sunlight and various kinds of flames) that carbon retains its reflecting power at very high temperatures; how high is not known with certainty.

Studies on the Properties of Explosive Substances.—M. Abel (extract from third memoir).—This treats of the influence of solids and liquids mixed with explosive matters.

The Physiological Phenomena Observed in High Regions of the Atmosphere.—M. Barraud.—The author does not believe in a sort of sickness peculiar to aëronauts such as has been lately described. In some ascents he experienced, at a barometric pressure of 373 m.m., great sickness and faintness. But he attributed it to the fact of his being at the lower part of the balloon, and so exposed to the action of impure hydrogen, which escaped through its excess of pressure. It was a sort of poisoning. When the boat was attached at a distance of 4 m. from the lower end of the balloon, the outflow of gas did not reach the voyagers, and all they experienced was a difficulty in breathing, acceleration of pulse, weakening of voice, and the effects of cold.

Fumeroles of Nisyros, and some Products of the Eruption in 1873.—M. Gorceix.

Mechanical Aptitude of Horses.—M. Sanson.—From observations by M. Fritz on traction of mowing and reaping machines in America and Europe, it is clear that the average mechanical aptitude of horses for useful work rises to over three millions of kilogrammetres per day, or more than 83 kilogrammetres per second—a considerably higher estimate than those made by Poncelet, Morin, and others. In a walking pace the weight of the body is always supported by at least two legs; but in the trot and the gallop there is, between each application, an instant in which the body is suspended in air, and has to overcome gravity. The author has estimated that the mean effort necessary in trot and gallop is about 0·10 of the weight of the body; while for walking pace it is only 0·05. Now the farm horses about Paris weigh on an average 651 kilogrammes, and give about 2,500,000 kilogrammetres of disposable or useful work per day of ten hours. They thus give a total force necessary to produce $2{,}500{,}000 + 650 \times 0{\cdot}05 \times 3600 \times 10 = 3{,}670{,}000$ kilogrammetres. M. Sanson shows that the total work of two millions of kilogrammetres, which he had taken in determining the mechanical coefficient of the food, is only the minimum of general aptitude of horses.

Studies and Experiments on the Metallic Sulphides.—M. Berthelot.—A continuation of the author's thermochemical researches. Though interesting and important, the paper is not adapted for abstraction.

Action of Distilled Water upon Lead.—M. Is. Pierre.—When steam is passed through a leaden worm, the water condensed is often charged with lead to such an extent as to appear opalescent, and almost milky. In one experiment 34 litres of condensed water gave on filtration 2·54 grms. hydrated carbonate of lead, or 0·0747 grm. per litre. The filtrate, which was very bright, on treatment with sulphuretted hydrogen gave only doubtful signs of the presence of lead. 1 litre of the filtrate was evaporated after previous treatment with carbonate of ammonia, 0·00375 grm. of a plumbiferous residue was obtained, which took, in contact with sulphuretted hydrogen, the usual colour.

Determination of Clay in Arable Soils.—Th. Schlœsing.—The separation of clay, sand, and calcareous matter by levigation is deceptive, since the last lot, supposed to contain the clay, includes in reality whatever is of extreme tenuity, whether sand, lime, or true clay. Two soils which give the same result by levigation may be exceedingly unlike if the last lot in the one consists of clay, and in the other of a mixture in which an extremely fine sand predominates. The author takes a sample of 5 grms., previously freed from stones and organic matter, made up into a paste with a little water, and rubbed up with the finger in a capsule. More and more water is gradually added, and the suspended matter is poured off. By constantly adding water and rubbing, nothing remains in the capsule but sand, which is rubbed until it yields nothing more to water, and is then thrown into the vessel in which all the washings and decantations have been united. The coarse sand is now separated in the ordinary manner by decantation and washing, dried, weighed, and the calcareous sand and organic particles determined in the ordinary manner. The fine sand, calcareous matter, and clay are now found suspended in 300 to 400 c.c. of water. Nitric acid is now added in small successive quantities, stirring repeatedly on each addition until the lime is dissolved, and the liquid remains clear. The clay is, in fact, coagulated by the salts of lime formed, but the same clearness is noticed when the soil is quite deprived of calcareous matter. It is due to the presence of free acid. Traces of hydrochloric, nitric, or sulphuric acid have the power of coagulating clay as decidedly as calcareous or magnesian salts. After this treatment with acid the mixture of clay and fine sand is filtered and washed. As soon as the calcareous salts, and the free acid are eliminated, the filtrate passes turbid, and filtration becomes difficult. The clay has then resumed its colloidal property of diffusion in pure water. The whole is then washed out of the filter into a precipitating glass of 2 litres capacity. The amount of water consumed in washing the filter clean is, at most, 150 c.c. Upon the mixture we pour 1 to 2 c.c. of liquid ammonia, and digest for one hour. The glass is then filled up with pure water, stirred, and set aside for twenty-four hours. After this time the amount of fine sand remaining suspended is unimportant. The clay-liquid may then be drawn off by means of a syphon. The residue is washed into a capsule, weighed, and dried. It is fine sand, but is generally confounded with clay. On its surface there is generally found a brown coating which contracts as it dries and separates from the sand. It consists of organic matter rich in oxide of iron. The argillaceous liquid is coloured by a compound humate of ammonia, ferric oxide, and alumina. On neutralising the ammonia, and acidifying slightly, the clay and the organic matter fall together. To separate these two colloids as far as possible, a few grammes of sal-ammoniac are dissolved in the alkaline liquid. The clay coagulates whilst the humate remains suspended. When the liquid has become clarified by standing it is decanted as far as possible, the rest, along with the clay, is thrown on a tared filter, dried at 100°, and weighed. The amount of sal-ammoniac varies with the quantity of humates present. The ordinary determinations of clay in soils are far too high.

Method of Determining Phosphoric Acid.—M. F. Jean.—The author dissolves the phosphatic matter in nitric acid, and the solution separated by filtration from insoluble matters is mixed with a slight excess of ammonia. Citric acid is then added, which dissolves the precipitate formed by the ammonia, and yields a perfectly clear acid solution, which is boiled for some time with acetate of uranium. The yellowish precipitate formed is collected on a filter, washed with boiling water, dried, ignited, and weighed. It contains 20·04 per cent of phosphoric acid. The filtrate, on examination with molybdate of ammonia, is found free from phosphoric acid.

Influence of the Presence of Nitrogen in Textile Fibres on the Direct Fixation of Aniline Colours.—E. Jacquemin.—This paper has been already noticed in the Chemical News.

Reimann's Farber Zeitung, No. 15, 1874.

This number contains a continuation of the directions for dyeing and finishing plushes; receipts for dyeing upon wool, woollen yarn, or piece goods orange, red, and blue capable of resisting fulling; shades upon wool from red to brown with a mixture of fustic and madder, to which, according to shade, cochineal, logwood, or orchil is added; and a light chocolate upon wool.

Detection of Artificially Coloured Wine.—Solution of blue vitriol, 1 part to 10 of water, if added to genuine wine destroys the colour without turbidity. Coloured wine is turned a violet-blue by the same reagent, and rendered slightly opaque. Baryta-water (1 : 10) destroys the colour of genuine wine almost entirely, and causes a slight turbidity. Artificially coloured wine is turned violet-blue or a blue green, and is rendered turbid at the same time. It must be understood that an uncoloured wine is necessarily genuine, but that one artificially coloured may still be the genuine juice of the grape.

There are also receipts for a methyl green and a dark chamois on cotton yarn; a reddish drab, a blue-drab grey, and a yellow-grey on silk; a scarlet and ponceau on shoddy, and a bronze on alpaca.

Ménard replaces yolk of egg in tanning and leather dyeing with stearin made up into an emulsion.

Commaille infers from his experiments that corallin is most easily and plentifully formed at 150°. At this temperature 100 parts of phenol yield in six hours 26 of corallin. Of the oxalic acid employed, 72 per cent can be recovered from the mother-liquor. On digesting the mother-liquor with lead oxide we obtain parathionate and thioamylate of lead. On filtration after digestion a fine red compound of lead oxide and corallin separates out. The proportion of lead in this compound is not constant. The commercial corallin has hitherto been taken for an amide of the yellow. Commaille consider this unlikely. Yellow coralline yields a red compound, both with ammonia and other bases, without any rise of temperature. The solution of yellow corallin in ammoniacal water yields the same products of decomposition as the artificial red. Commaille, therefore, considers that yellow corallin is not an acid, as hitherto supposed, and that red corallin is not the amide of the yellow. The quantity of oxalic acid employed is far too large. Corallin yields no definite metallic compounds, but merely coloured lakes.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, April 13, 1874.

Certain Derivatives of β-Dinitrophenol.—H. Salkowski and G. Rehs.—The authors have obtained and examined β-dinitro-anisol, $C_6H_3(NO_2)_2OCH_3$; β-dinitrophenol, $C_6H_3(NO_2)_2NH_2$; and di- and tri- (?) nitrobenzol from β-dinitranilin.

Constitution of Dinitrobenzol.—H. Salkowski.—A hypothetical paper.

Chloride of Antimony as Reagent for the Salts of Cæsium.—R. Godeffroy.—If the solution of a salt of cæsium, not too dilute, is mixed with a solution of chloride of antimony in concentrated hydrochloric acid a white crystalline precipitate is at once formed, which does not disappear on the addition of hydrochloric acid. The solutions of the other alkali metals yield no precipitate if similarly treated. The precipitate may be collected on a filter, washed with concentrated hydrochloric acid, and re-dissolved in the same acid much diluted. The solution yields on evaporation well-developed, hard, permanent crystals, belonging to the hexagonal system. They may be obtained pure by repeated solution in dilute hydrochloric acid, and re-crystallisation. They contain 33·419 per cent of chlorine, and of antimony 30·531 per cent, corresponding to the formula $S6Cl_3CsCl$. This salt is decomposed on the application of heat, and on treatment with water. It is completely soluble in dilute acids. Charples and Stolba observed a similar reaction of the cæsium salts with stannic chloride. The salts of rubidium, however, give with chloride of tin a precipitate which is very sparingly soluble. The presence of ammonia in the liquid contaminates the double chloride of cæsium and tin with pink-salt. The reaction with chloride of antimony is not interfered with either by ammonia or rubidium. The liquid must be strongly acid to prevent the precipitation of oxychloride of antimony.

Protamin—a New Organic Base Found in the Seminal Filaments of Rhine Salmon.—F. Miescher.—These filaments are easily separated from the secretion, and contain—Lecithin, 7·5 per cent; cholesterin, 2·2 per cent; fat, 4·5 per cent; albuminoids, 10·3 per cent; and, as its chief constituent, 48·7 per cent of nuclein, an albuminoid free from sulphur and rich in phosphorus. Its properties are acid, and it forms an insoluble saline compound with the base protamin. The latter is composed of—

Carbon	43·72
Hydrogen	8·50
Nitrogen	28·34
Oxygen	19·44
	100·00

or $C_9H_{21}N_5O_3$.

Heat of the Formation of the Oxides of Nitrogen.—Julius Thomsen.—A controversial notice of Berthelot's papers, *Comptes Rendus*, vol. lxxviii., pp. 99, 162, and 205.

Thiobenzyl and Thioaniline.—F. Krafft.—Merz and Weith consider thioaniline as aniline in which the hydrogen of the benzol is replaced by sulphur. It may be regarded as thiobenzol in which hydrogen is replaced by the amid group.

Sensibility of Bromide of Silver to Colours called Chemically Inactive.—E. Schultz Sellack.—A critique on Vogel's paper, *Berichte*, No. 17, 1873, p. 1302.

Aromatic Silicium Compounds.—A. Ladenburg.—The author describes the action of zinc-ethyl upon silicum-phenyl-chloride, and also the silicium-tolyl compounds.

Arsenio-Molybdic Acid Compounds.—Hermann Seyberth.—If a solution of arsenic and molybdic acids is heated to boiling in presence of ammonia for some time, a crystalline precipitate is formed, which after purification gave results which agree with the formula—

$$As_2Mo_7O_{29}H_6(NH_3)_2+4H_2O.$$

The compound dissolves in hot water, and gives with excess of silver nitrate a pale yellow precipitate, and white precipitates with salts of baryta and lead.

Isothionic Acid Amid.—Hermann Seyberth.—The body obtained consisted of—

C	19·20
H	5·10
N	11·20
S	25·60

and agreed with the formula $C_2H_7NSO_3$. It cannot be taurin as it gives off ammonia on treatment with water.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process for silvering mica for use in the construction of reflectors and reflecting shades. Edward Otto Woerteler, Castle Street, Falcon Square, Middlesex. (A communication from William Marot Marshall, Philadelphia, Pennsylvania, U.S.A.). September 27, 1873.—No. 3152. Mica, free from metallic deposit, is first washed in nitric acid, and then well rinsed in water, after which it is placed in vats of earthenware. The sheets of mica are arranged back to back in pairs vertically and endwise, leaving a small space between each pair, so that only one side of each gets coated. When the mica is properly arranged, the vats are filled up with the following solution, the proportions of the ingredients forming which may be here stated as an example for a small quantity of mica as follows, viz.:—I place 1 oz. of nitrate of silver in a bottle containing 1 quart of pure water, and allow it to thoroughly dissolve. In another bottle, also containing 1 quart of pure water, 1 oz. of glucose is dissolved. When the nitrate of silver is dissolved, a small quantity of aqua ammonia is added; this renders the clear solution muddy; a little more ammonia is then added till the solution again clears. The contents of the two bottles are then mixed, and the whole poured into the receptacle containing the mica, which is then put in a warm place to encourage deposit, and, when sufficiently coated, is removed from the receptacle, and thoroughly rinsed in water, and hung up to dry, after which it may be coated with spirit-varnish.

Improved pneumatic drainage works for removing and utilising fæcal matter. Charles Thieme Liernur, of the firm of Liernur and De Bruyn Kops, engineers, Frankfort on the Maine, Prussia. September 30, 1873.—No. 3168. The invention relates to a process for rendering human excrement useful instead of noxious, by means of pneumatic drainage-works. 1. By arrangement of pneumatic drain-pipes in the street. 2. By street reservoirs. 3. By arrangement of branch-pipes. 4. By using a stopping-valve for branch-pipes. 5 By applying tension-valves to both branch-pipes and main-pipe. 6. By adapting water-closets to my pneumatic drainage system. 7. By the use of a stationary air-pump engine, with "poudrette" attachment, this arrangement being for the purpose of spreading the fæcal matter, immediately after its arrival in the central reservoir, in thin layers upon surfaces exposed to the vacuum. The whole being an improvement on my invention for which Letters Patent were granted on May 3, 1869. This improvement being a method of removing human excrements out of houses and cities, and converting them into a dry manure or poudrette with one and the same steam-engine in one continuous unbroken process, employing therefor a system of pneumatic sewerage which admits water-closets, and by which no locomobile engines, waggons, or horses are required in the streets, nor any metal or other valves whatsoever for shutting off the branch-pipes from the main-pipe.

A new disinfectant and oxidising agent. William Whitthread, analytical chemist, Liverpool. September 30, 1873.—No. 3169. When manganese tetrachloride is added to oxidisable bodies it is decomposed, and yields 2 equivalents of nascent chlorine and 1 equivalent of manganese dichloride. I use also the higher bromides and iodides of manganese and other metals. When I treat liquids, such as sewage and impure waters, with the above disinfectants, I sometimes remove from the treated liquid, the metallic chlorides, or bromides, or iodide which they would contain, by the addition to the liquids of alkalies, alkaline carbonates, or the alkaline earths or their carbonates, or by passing the liquids through filters made of the alkaline earthy carbonates alone or mixed with other substances, such as sand and gravel.

Improvements in the preparation of colouring matters, and in the application of the same to the dyeing, printing, and marking of textile and other fabrics. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. September 30, 1873.—No. 3176. The chief object of this invention is to provide a colouring matter which, when used in dyeing, or printing, or marking fabrics, will produce a permanent stain, impression, or marking, in contradistinction to the fugitive or changeable effects now obtained. To this end a mixture is prepared of extract of logwood, of chromic acid (or one of its salts), and aniline black or aniline blue-black, soluble in water.

Improvements in the production of sulphuric acid. Hermann Sprengel, Gloucester Street, Belgrave Road, Middlesex. October 1, 1873.—No. 3189. In the production of sulphuric acid as now generally adopted, it is necessary to introduce into the chambers jets of steam in order to effect the desired combination of the several gases employed for the production of sulphuric acid. Now this invention relates, first, to the employment as a substitute for a jet or jets of steam, or in conjunction therewith, of water or of acidified aqueous solutions either of sulphuric acid or of nitric acid, the same being converted by means of jets of steam, or by means of jets of air at an elevated pressure, or by any other means, into an exceedingly finely-divided condition of the fluid or into spray. Such finely-divided condition of the fluids employed acting in a manner similar to steam, but forming an economical substitute therefor. One other part of my invention consists in the employment of sulphuric acid in a finely-divided condition or spray for effecting the absorption of the lower oxides of nitrogen contained in, or escaping from, the sulphuric acid chambers. Another part of my invention relates to the employment of sulphuric acid containing in solution nitric acid or the lower oxides of nitrogen or mixtures of the same in a finely-divided condition or spray, so as to utilise the oxides of nitrogen contained therein for the production of sulphuric acid in the sulphuric acid chambers.

Improvements in the production of ozone, and in the application of the same to various useful purposes. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Pierre Isidore David, Paris). October 2, 1873.—No. 3190. It is proposed, according to this invention, to apply ozone to the decolourisation or bleaching of organic matters in such a manner as to effect their decolourisation by the gaseous method, whilst obviating the wetting of the matters operated upon. This invention embraces certain processes for the preparation of ozone. *1st process, by chlorine, carbonic acid gas, and ammoniac.*—Chlorine in a gaseous state is produced in a closed receptacle by one of the ordinary means. The chlorine obtained is introduced into a receptacle containing the materials to be decolourised; there is then projected into the receptacle containing the materials a rapid current of carbonic acid gas obtained by the ordinary means. The apparatus in which the carbonic acid is produced communicates with another apparatus containing liquid ammonia. The ammoniacal fumes or vapours enter the carbonic acid gas, and are conducted by it into the receptacle. The presence of the ammoniac and carbonic gases neutralises the chlorhydric acid, whilst maintaining and accelerating the decolourisation. *2nd process, by permanganate of lime and sulphuric acid.*—This permanganate is obtained by the reaction of bi-oxide of manganese on lime by means of heat. It is placed in a closed receptacle which communicates with another receptacle containing the materials to be decolourised. By gradually pouring sulphuric acid through a tube on to the permanganate of lime, ozonised oxygen is evolved, which passes into the other apparatus, and produces the decolourisation. *3rd process, by phosphorus and acetic acid.*—By causing air which has bubbled up through acetic acid, contained in an adjacent receptacle, to bubble up through the water which contains the half-submerged phosphorus. The receptacle which contains the phosphorus communicates by a tube with the receptacle which contains the materials to be decolourised, and the decolourisation is effected. The bubbling action is obtained by means of an exhaust or blast fan. *4th process, by alum, chalk, and sulphuric acid.*—A saturated solution of alum is prepared by elevating the temperature to about 140° or 160° F. To this is added carbonate of lime in powder, in the proportion of about equal weight to that of the alum. A quantity of sulphuric acid, about equal to that of the alum or chalk, is then poured over the whole. Effervescence is produced, and the gas which is evolved is conducted through a tube into a receptacle containing he materials to be decolourised, and effects their decolourisation.

NOTES AND QUERIES.

Oxidising Hydrosulphuric Acid.—Could any of the readers of your valuable paper inform me if there is any cheap and convenient method for oxidising hydrosulphuric acid, (H_2S)?—H_2S.

Filtration on a Large Scale.—(Reply to E. B. M.).—The writer has found the patent filter press made by Messrs. Needham and Kite, of Vauxhall, and described in the "Report of Her Majesty's Commissioners—Exhibitions 1862 and 1867," the most useful apparatus for filtration on the large scale.—H. E. D.

Lime Crucibles.—(Reply to "Delta").—For melting platinum by the oxyhydrogen flame, these can be readily made by scooping out a suitable hollow in a piece of dense quick-lime. A dome or cover can be fitted of the same material, and a channel, groove, or hole be made to admit the flame.—G. A. K.

To Remove Gold Letters from Wire Blinds.—(Reply to J. S.).—Pour a little mercury over the letters, the blind being first placed on a table. Allow this to remain until an amalgam is formed with the gold, to be removed with a small brush. If any varnish be present to interfere with this, apply a little methylated spirit before and after.—G. A. K.

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THE

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AND

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THE CHEMICAL NEWS.
VOLUME XXX.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 762.—FRIDAY, JULY 3, 1874.

THE COMMITTEE ON ADULTERATION.

The Select Committee on the Adulteration of Food completed their task of receiving evidence on the 22nd ult. Among the chemists examined were Drs. Hassall, Cameron, Tidy, and Voelcker, and Messrs. Wanklyn, Allen, Bartlett, and Sutton. Although the leading public analysts and workers on the detection of adulteration are fairly represented here, and we might therefore have expected that the matter would be thoroughly sifted, it is remarkable how many notorious adulterations were left absolutely unnoticed, and how various were the opinions expressed on different subjects. Thus Dr. Hassall and Dr. Voelcker thought the facing of tea should be prohibited, though the latter chemist "would not have considered 1½ per cent of facing (the usual amount) an adulteration." Mr. Wanklyn thought faced tea should not be regarded as adulterated, while Mr. Allen considered the facing an adulteration when black tea was converted into green, and thus given a fictitious value, while he would not condemn a faced green tea merely coloured more brightly to suit the public taste.

But perhaps the most startling difference of opinion was on the subject of butter, Dr. Voelcker and Mr. Wanklyn having apparently denied the possibility of detecting foreign fats, while Dr. Hassall and Dr. Tidy were equally certain of the possibility. There can be little doubt that the recognition of such adulteration in butter is frequently possible, but we can well imagine that there are cases, like that referred to by Mr. Wanklyn, in which their detection is impossible, and few chemists will doubt Mr. Wanklyn's ability to concoct a mixed butter in which Dr. Tidy would fail to detect the foreign fat.

Dr. Voelcker and Mr. Wanklyn, though of the same mind with regard to butter, were at variance on the subject of milk, Mr. Wanklyn maintaining the accuracy of his "standard," and Dr. Voelcker disputing the possibility of detecting much less than 25 per cent of water. We quite agree with the latter chemist that, if we rely on the *density* of the milk (as recently advocated by him), less than 25 per cent of water cannot be detected with certainty, but then no chemist but Dr. Voelcker would rely on the density of milk for the detection of adulteration. In fact, Dr. Voelcker strongly objected to the use of any standards at all, and thought every case should be judged on its merits. Dr. Voelcker is also reported to have said that he would not himself accept a position as a public analyst, as it would lead to him being classed with chemists who did not stand very high in the profession. We do not for a moment doubt that Dr. Voelcker could have held such a position had he desired to do so, and the very fact that chemists of good standing have declined the posts is the reason that many of the appointments are held by third-rate men. In casting this slur on a body of chemists who have had many difficulties to overcome, Dr. Voelcker seems to forget that, as an agricultural chemist ,he is already classed with "some chemists who do not stand very high in the profession." On the whole, we are rather inclined to agree with Dr. Hassall, that there is more fault to be found with the Act than with the analysts, and that chemists who are always ready to give evidence for the defence should be regarded with suspicion.

Most of the chemists examined were asked their opinion as to the desirability of appointing referees for the decision of disputed cases. Dr. Hassall thought such an appointment was unnecessary, while Dr. Voelcker and others recommended the utilisation of the Inland Revenue Laboratory at Somerset House for the purpose, a plan which Mr. Wanklyn did not think would command the confidence of the profession. While admitting the advantages of the Inland Revenue Laboratory, Mr. Allen preferred the appointment of independent referees, to be elected annually by the public analysts themselves, a plan which he thought would ensure the election of the best men, and prevent the evil effects of personal influence, which so often causes the appointment of second-rate or incompetent men to important posts. Mr. Allen also advocated the personal attendance of the analyst at the hearing of the case, on the ground that his statement was the very cause of the prosecution, and that he ought to be confronted with the defendant. Though this argument has some force, and the personal attendance of the analyst may be possible in the boroughs, it would certainly be a mistake to make it essential to the case, as it would involve great difficulties in the country districts, and might cause many cases in which adulteration was detected to remain unreported.

Dr. Tidy is reported to have said that he had examined about 1000 samples of food a month, and, unless we attribute to him a capacity for work such as might have been possessed by Briareus, we must agree with Dr. Voelcker that "this is not the way that analyses should be made, for it was impossible, from the number made, to take every case carefully, and thoroughly examine every sample with the *minutiæ* necessary to arrive at the truth." And yet Dr. Voelcker advocated the concentration of the appointments in the hands of a few analysts, a course which would necessarily tend to increase the very evil he deplores!

On the whole, we believe it is impossible to over-rate the good done by the inquiry, and we are glad to observe that the chemists examined were unanimous in their opinion of the good effected by the Act, imperfect as it at present is.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.

(Continued from p. 222.)

II. Tea (*concluded*).

Moisture.—The moisture of tea in the commercial condition is generally about 6 or 8 per cent of the weight. All the data given of the proportions of tannin, insoluble matter, ash, &c., refer to the tea in its commercial state. The lowest recorded percentage of moisture is 4·95, and the highest about 10.

Extractive Matter.—Some chemists prefer to evaporate to dryness the aqueous decoction of the tea instead of weighing the residual leaves. It is evident that the extractive matter, *plus* the moisture, subtracted from 100·0, will be the percentage of insoluble matter. Thus Peligot found—

	Green Tea (Gunpowder).	Black Tea (Souchong).
Moisture	10	8
Extractive matter ..	47	43
Insoluble matter ..	43	49
	100	100

The most recent published determinations of the extractive matter in tea are those of Mr. Wigner,[*] but, as in almost every instance the ash is abnormally high, in one case even exceeding the total ash found in the original tea, his results must be accepted with caution.

Theine.—Although the very variable proportion of theine present in tea prevents the estimation from being of much value for the detection of adulteration, it may sometimes be of interest to determine the amount present in a particular sample. The recorded percentages of theine vary greatly even with the same observers, Mr. Bell, for instance, having found amounts varying from 1·9 to 5·8 per cent. Stenhouse places the average proportion of theine in black tea at 2 per cent, while Peligot found upwards of 6 per cent.

The advantages of the various methods employed for the estimation of theine have been compared by R. Weyrich.[†] I have myself used Peligot's, Mulder's, and Zöller's methods, and am not satisfied with either of them on the score either of simplicity or accuracy. Zöller's plan is the least satisfactory of the three. A good process for the estimation of theine is still a desideratum, but I have employed the following method of *extracting* theine with very satisfactory results, though it is valueless for the *determination*, owing to the decomposition of some of the theine by the lime:—

The tea is finely powdered and mixed into a paste with slaked lime and water, and allowed to rest for some hours, with occasional stirring. The mixture next is dried at a steam heat, and repeatedly treated with boiling benzol in an apparatus allowing of the condensation of the vapour, until no more colouring matter is extracted. The liquid is filtered, and the benzol distilled off. The residue, consisting of impure theine, is boiled with water, and the solution filtered while hot. On evaporation of the aqueous solution, the theine is deposited in long silky crystals, often grouped into tufts. It is usually obtained quite pure by the above treatment.

Theine being a very weak base, the salts are readily decomposed even by dilution. One of its most remarkable salts is the tannate. If a solution of gallo-tannic acid be added in excess to a cold aqueous solution of theine, a white precipitate of tannate of theine is produced. This is far more soluble in hot water than in cold, so that at a certain temperature, dependent on the concentration of the solution, the liquid becomes clear, and, if the vessel containing it be cooled externally by a jet of water, a local precipitation takes place where the cooling occurs.[‡] On again heating the liquid it becomes clear, and the experiment may be repeated any number of times, a few degrees difference of temperature being sufficient to produce the change. On standing the precipitate collects at the bottom of the vessel as a sticky mass, capable of re-solution without change on application of heat.

The above facts clearly prove the necessity of using hot water for extracting the theine from tea, and seem to indicate the probable cause of the turbidity noticed when strong infusions of certain Indian teas are cooled.

According to Mulder, tannate of theine contains 41·9 per cent of theine.

Under the action of oxidising agents, theine behaves like uric acid, and forms a coloured product analogous to alloxantin, capable of conversion into a murexide-like substance by the action of ammonia. These facts may be utilised for the detection of theine, but the test requires to be applied with caution.

The residue supposed to contain theine is moistened with strong hydrochloric acid, a small crystal of potassium chlorate is added, and the mixture exposed to a steam heat for some minutes, after which it is subjected cautiously to the action of ammonia, an excess being avoided. A crimson or purple colouration proves the presence of theine.

Theine is fusible at 178° C., and sublimes unchanged at 185°, and is deposited in beautiful acicular crystals. Theine is readily soluble in hot water, the solution depositing on cooling a mass of crystals of the composition $C_8H_{10}N_4O_2+H_2O$.

Analyses of Tea.

In the following tables I have given the results of the analyses of a number of genuine teas. I have only been able to avail myself of recent analyses, partly because the methods of examination are new, and partly because most observers have omitted to mention the kinds of tea employed, or to indicate the details of the methods used, thus rendering it impossible to utilise their results:—

Percentage of Theine in Tea.

	Percentage.	Kind of Tea.	Observer.
Highest amount ..	6·21	Gunpowder	Peligot.
" "	5·8	—	Bell.
Lowest amount ..	1·9	—	Bell.
" "	1·02	Congou	Stenhouse.
Average	2·00	Black	Stenhouse.

The common descriptions of tea often contain as much theine as the finest.

Percentage of Tannin in Green Tea.

	Percentage.	Kind of Tea.	Observer
By gelatin—			
Highest	19·2	Mixed hyson and gunpowder	Allen.
Lowest	10·12	Very fine gunpowder	Bell.

Percentage of Tannin in Black Tea.

	Percentage.	Kind of Tea.	Observer.
By gelatin—			
Highest	15·2	Very strong Oolong congou	Allen.
Lowest	9·5	Finest Souchong	Bell.
Average of 8 ..	10·97	Congou and Souchong	Bell.
By lead—			
Highest	11·6	Horniman's black	Allen.
Lowest	8·5	Broken leaf congou	Allen.
Average of 28	10·0	Various	Allen.

The proportion of tannin appears rather to *increase* as the leaf gets older.

---

[*] *Pharmaceutical Journal*, May 16, 1874.

[†] *Journ. Chem. Soc.*, 1873, p. 1264.

[‡] By using a thin beaker containing a solution of tannate of theine at a temperature just above the precipitating-point, it is possible, by adroitly cooling the exterior with a jet from a washing-bottle containing very cold water, to cause the precipitation to follow the track of the stream, and thus to write with water. The extreme sensitiveness of tannate of theine to change of temperature might enable it to be employed as a thermascope.—A. H. A.

Percentage of Insoluble Matter in Black Tea.

	Percentage.	Kind of Tea.	Observer.
On whole leaves—			
Highest.. ..	60·12	Kaisow Congou	Bell.
Average of 5..	58·77	Congou and Souchong	Bell.
On pounded tea—			
Highest.. ..	53·6	Moning Congou	Allen.
Lowest	46·7	Pekoe	Allen.
Average of 13	49·0	Various	Allen.

The insoluble matter increases somewhat with the age of the leaf.

Percentage of Ash in Tea.

	Highest Amount.	Lowest Amount.	Average.	Observer.
Total ash	6·06	5·30	(of 7) 5·75	Wanklyn.
" "	6·15	5·32	(of 9) 5·66	Wilson.
" "	5·99	5·53	(of 24) 5·66	Wigner.
" "	6·34	5·30	(of 10) 5·75	Allen.
Soluble in water	3·80	3·06	(of 10) 3·34	Allen.
" "	3·35	2·75	(of 24) 3·01	Wigner.
" "	3·33	2·66	(of 9) 3·00	Wilson.
Alkalinity as K_2O	1·88	1·36	(of 20) 1·62	Wigner.
Silica	0·71	0·16	(of 24) 0·44	Wigner.
"	0·82	0·20	(of 9) 0·53	Wilson.
Ferric oxide ..	0·09	0·03	(of 9) 0·063	Wilson.
" "	0·26	0·16	(of 3) 0·21	Hassall.

A low soluble ash usually indicates an inferior tea. Assam tea, however, frequently gives a low soluble ash. The composition of the ash of tea varies somewhat with the age of the leaf, the potash and phosphoric acid diminishing as the leaf becomes aged.

The following analyses by Zöller show the composition of the ash of tea before and after infusion:—

	Original Tea.	Infused Leaves.
Potash	39·22	7·34
Soda	0·65	0·69
Magnesia	6·47	11·45
Lime	4·34	10·76
Ferric oxide	4·38	9·53
Manganous oxide	1·63	1·97
Phosphoric acid	14·55	25·41
Sulphuric acid..	trace	trace
Silica..	4·35	7·57
Carbonic acid	24·30	25·28
Chlorine	0·81	trace
	100·00	100·00

It will be observed that more than three-fourths of the total potash is lost by infusion, so that the alkalinity of the ash is a valuable guide in determining whether a sample of tea has been mixed with previously infused leaves; but as the percentage of potash also diminishes as the leaf ages, the conclusion is somewhat fallacious. The percentage of phosphoric acid, on the other hand, is *diminished* by ageing, and *increased* by infusion, so that we have, in its estimation, another most valuable means of recognising the presence of exhausted leaves.

The following analyses show the proportions of the principal constituents of previously infused leaves:—

	Exhausted. (Bell.)	Maloo Mixture. (Bell.)	Mixed Exhausted. (Allen.)	Exhausted. (Allen.)	Once Infused. (Allen.)	Exhausted. (Wigner.)	Exhausted. (Wigner.)
Moisture..	10·16	8·45	9·5	—	11·1	—	—
Insol. matter (on whole leaves)..	77·21	70·0	—	—	78·5	—	—
Ditto (on powdered tea)	—	—	75·2	72·0	72·3	—	—
Tannin (by gelatin) ..	0·9	0·88	—	—	3·3	—	—
Tannin (by lead)	—	—	2·8	4·0	3·2	—	—
Gum (precipitated by alcohol	2·5	5·75	—	—	3·8	—	—
Soluble ash	—	—	0·52	0·58	0·75	0·41	0·83
Alkalinity of ash.. ..	—	—	—	—	—	0·43	0·89

Certain kinds of tea are especially liable to particular adulterations, and therefore the examination necessary must depend on the nature of the sample.

Adulteration by siliceous and magnetic matter is almost confined to caper, lie, and gunpowder teas, and mixtures containing them.

Extraneous astringents are often present in the above classes, and occasionally also in ordinary black tea.

Exhausted leaves are re-made into caper and gunpowder, and are also mixed with ordinary tea.

Foreign leaves are met with in teas of all classes.

Black tea is sometimes painted, and sold as gunpowder tea.

(To be continued.)

ON CONIFERINE, AND ITS CONVERSION INTO THE AROMATIC PRINCIPLE OF VANILLA.*

By FERD. TIEMANN and WILH. HAARMAN.

The sap of the cambium of coniferous trees contains a beautiful crystalline glucoside, coniferine, which was discovered by Hartig, and examined some years ago by Kubel, who arrived at the formula $C_{24}H_{32}O_{12}+3$ aq. A minute study of this compound leads us to represent the molecule of coniferine by the expression $C_{16}H_{22}O_8+2$ aq, the percentages of which nearly coincide with the theoretical values of Kubel's formula.

Submitted to fermentation with emulsine, coniferine splits into sugar and a splendid compound, crystallising in prisms, which fuse at 73°. This body is easily soluble in ether, less so in alcohol, almost insoluble in water; its composition is represented by the formula $C_{10}H_{12}O_3$. The change is represented by the equation—

$$C_{16}H_{22}O_8+H_2O=C_6H_{12}O_6+C_{10}H_{12}O_3.$$

Under the influence of oxidising agents, the products of fermentation undergoes a remarkable metamorphosis. On boiling it with a mixture of potassium bichromate and sulphuric acid, there passes with the vapour of water, in the first place ethylic aldehyd, and subsequently an acid compound soluble in water, from which it may be removed by ether. On evaporating the ethereal solution, crystals in stellar groups are left behind, which fuse at 81°. These crystals have the taste and odour of vanilla.

An accurate comparative examination has proved them to be identical with the crystalline substance which constitutes the aroma of vanilla, and which is often seen covering the surface of vanilla pods.

On analysis, the crystals we obtained were found to contain $C_8H_8O_3$. This is exactly the composition which recent researches of Carles have established for the aromatic principle of vanilla. The transformation of the crystalline product of fermentation into vanilline is represented by the following equation:—

$$C_{10}H_{12}O_3+O=C_2H_4O+C_8H_8O_3.$$

To remove all doubt regarding the identity of artificial vanilline with the natural compound, we have transformed the former into a series of salts, which have the general formula $C_8H_7MO_3$, and into two substitution products, $C_8H_7BrO_3$ and $C_8H_7IO_3$, both of which had previously been prepared by Carles from the natural compound.

In order further to elucidate the nature of vanilline, we have submitted this body to fusion with alkali. The product of this action is a well-known acid discovered by Strecker, and described by him as protocatechuic acid, $C_7H_6O_4$, which is thus formed:—

$$C_8H_8O_3+HO=C_7H_6O_4+H_2O+CO_2.$$

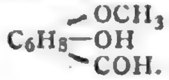
We have identified this substance by analysis, by the study of its reactions, and also by transforming it into pyrocatechine, $C_6H_6O_2$.

$$C_7H_6O_4=C_6H_6O_2+CO_2.$$

The transformation into protocatechuic acid fixes the constitution of vanilline. This compound is the methy ated aldehyd of protocatechuic acid; its composition referred to benzol is represented by the formula—

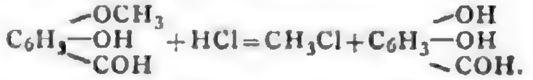
---

* A Paper read before the Royal Society



$$C_6H_8\left\{\begin{array}{l}OCH_3\\OH\\COH.\end{array}\right.$$

Indeed, submitted under pressure to the action of hydrochloric acid, vanilline splits into chloride of methyl and protocatechuic aldehyde—

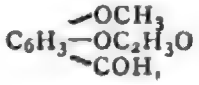


$$C_6H_3\left\{\begin{array}{l}OCH_3\\OH\\COH\end{array}\right. + HCl = CH_3Cl + C_6H_3\left\{\begin{array}{l}OH\\OH\\COH.\end{array}\right.$$

A corresponding action takes place with hydriodic acid; but in this case the aldehyd is destroyed.

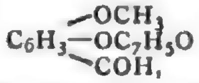
An additional proof of the correctness of our view regarding the constitution of vanilline is obtained by treating this substance with acetic anhydride and benzoyl chloride.

The action did not go beyond the formation of the compounds—



$$C_6H_3\left\{\begin{array}{l}OCH_3\\OC_2H_3O\\COH,\end{array}\right.$$

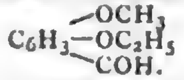
and—



$$C_6H_3\left\{\begin{array}{l}OCH_3\\OC_7H_5O\\COH,\end{array}\right.$$

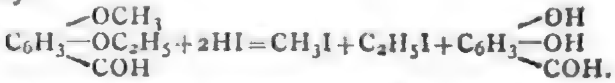
showing that vanilline does not contain more than one hydroxylic group.

The constitution of vanilline being thus made out, there could be no doubt regarding the structure of the product of fermentation from which vanilline arises. This compound is the ethylic ether of vanilline—



$$C_6H_3\left\{\begin{array}{l}OCH_3\\OC_2H_5\\COH.\end{array}\right.$$

That such is the constitution of the body is proved by the simultaneous formation of ethylic aldehyd when vanilline is formed. We obtained, however, an additional confirmation of this conception by submitting the product of fermentation to the action of hydriodic acid under pressure, when an alcohol iodide was formed, which we succeeded in separating into the iodides of methyl and ethyl—



$$C_6H_3\left\{\begin{array}{l}OCH_3\\OC_2H_5\\COH\end{array}\right. + 2HI = CH_3I + C_2H_5I + C_6H_3\left\{\begin{array}{l}OH\\OH\\COH.\end{array}\right.$$

The experiments we have described in this note were performed in the laboratory of Professor A. W. Hofmann, to whom we are deeply indebted for advice and assistance he has given us in the course of these researches.

ON THE

CONDITION OF THE IMPURITIES IN COAL-GASES OF HIGH AND LOW ILLUMINATING POWER.

By CHARLES R. C. TICHBORNE, Ph.D., F.C.S., M.R.I.A., &c.

In the years 1872 and 1873 I had an opportunity of trying some experiments in connection with the condition of the impurities in gas of a high standard (20 candles). My first experiments were instituted to see how far carbon was actually disseminated through the atmosphere from these gases, or whether a 20-candle gas would, as described by Professor Frankland, owe its higher illuminating power to the radiation of light from denser hydrocarbon vapours or from solid particles.* This enquiry, after a time, developed, as will be seen, into one of another character; but I will first detail my preliminary researches.

It is probable that the main increase in the illuminating power of a gas is due to the causes specified by Professor Frankland, but it is equally certain that, in practice, solid carbonaceous particles are more freely disseminated from the gas of a high standard than from a low one, say a 16-candle, the conditions being exactly similar as regards burner and supply of air. This fact may be determined in many ways. In one of my experiments four small chambers were constructed for the relative and optical examination of the atmospheres resulting from the combustion of these gases by the electric or lime light. Two chambers are required for the examination of one light; and the two experiments with the different gases under examination were simultaneously performed.

Filtered air was introduced in one of the chambers, in which the gas was burning from an ordinary fish-tail burner, and the products of combustion passed into the second, or dark chamber, through which passed a beam of bright light. It is very easy to arrange these compartments or chambers in such a manner that a comparative view of the results may be determined by the eye. The combustion of the gas must be regulated by watching the metres provided for the purpose of controlling the supply. It may be objected to such a mode of examination that the light impinging upon the clouds of heavy hydrocarbons would produce similar effects to solid carbon; but the carbon deposit can be virtually procured by placing cold plates of glass at stated distances over openings along the route of the escaping vapours. An arrangement was made by which cold water was allowed to flow at the back of the plates to keep them cool. These plates will reveal a slight deposit of carbon when examined by the electric or lime light, and from the relative examinations so effected by them, and the previous experiments, there could be little doubt that the high illuminating gas gave a greater deposit, *cæteris paribus*.

These experiments, however, were not followed up, because they gave no pronounced information. The results were not quantitative, and were only confirmatory, to a certain extent, of what our general observations have premised, viz., that 20-candle gas, as made practically in gas retorts, will deposit carbonaceous matter more fully than 16-candle gas. This question, however, is outside the question of illuminating intensity, and is an accidental but an accompanying fact. From my experiments, I am of opinion that coal-gas of the lowest standard, possessing any amount of luminosity worth mentioning, will show traces of this deposit when submitted to searching tests.

My attention was first attracted, in the winter of the year 1872, to the marked effect of the combustion-products of gas on some fabrics dyed with aniline colours, and from certain indications then perceived the following investigations were instituted:—I determined to investigate the products of combustion from different gases possessing different illuminating powers, chemically and quantitatively—the gases to be burnt in as nearly as possible the same condition as we should use them in our ordinary consumption. And as in these experiments my object was to obtain extreme gases, or gases which would present extreme phases as regards their condition, I arranged to have two in use, one of a low illuminating power, obtained by passing the ordinary gas at my disposal through a given volume of spirit. The gas played through the spirit in a specially-arranged vessel, and the results were remarkably uniform if the amount of spirit was regulated with each measure of gas. The spirit was found to be strongly impregnated with the hydrocarbons, and was rejected after each experiment. At the exit of the wash-bottle was arranged a short condensing apparatus of a simple nature, intended to eliminate as much as possible all liquids from the experimental gas. Even the spirit itself is, to a certain extent, found floating onwards, due to the attraction of liquids by miscible vapours. My gas with the high illuminating power was obtained by substituting the light petroleum hydrocarbons (boiling from 25° to 30° C.) for the spirit in the washing apparatus, using the same amount, and rejecting after each experiment as before.

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* *Vide* "On the Combustion of Hydrogen, Oxygen, and Carbonic Oxide under Great Pressure."—*Proc. Roy. Soc.*, vol. xvi., p. 419.

From the slowness of the combustion, and the necessary complications of the apparatus, it was quite impossible in such experiments to determine the actual illuminating power of the actual gas performing the experiments; but when I say that the gas used in one set of experiments marked on an average 12 to 12½-candle gas, and that the carbonised gas marked on an average 21 candles, I think there is little question but that there was margin enough to allow of any slight fluctuations there might be in this respect in the original gas with which I was manipulating.

The experiments were put on at the same hour, and all performed under as like a condition of circumstances as possible. The gas, when burned in Letheby's apparatus, gave 0·41 gr. of sulphur for each 10 feet, and may be considered as a fair specimen of a commercial gas.

The photometer used in these experiments was Bunsen's, with Letheby's modifications. Each observation was made with ten readings taken at minute intervals, and the average formed the determination.

From the unmistakable evidence of sulphurous anhydride ("sulphurous acid") found in a given sample of gas of a high illuminating power, determinations were instituted with regard to this substance, or rather, we should say, the condition of oxidation in which the sulphur molecule would be given off. It is hardly necessary to say that sulphur rarely passes to the burner as sulphide of hydrogen; if the gas-makers know their business, it is chiefly as sulphide of carbon that it exerts its deleterious influence. Let it be understood, however, that it is immaterial whether the sulphur is present as sulphide of hydrogen or sulphide of carbon; the products will be SO_2 or SO_3, sulphurous or sulphuric anhydride, according to the perfection of the combustion. The first action of heat upon bisulphide of carbon is to resolve it into its elements, carbon and sulphur, which are burnt, respectively, into carbonic acid and sulphurous anhydride, according to the following equation:—$CS_2+6O=CO_2+2SO_2$. Therefore we may consider that the combustion of bisulphide of carbon in coal-gas is tantamount to the combustion of sulphur itself. It is generally stated that the result of the combustion of sulphur in atmospheric air or oxygen is sulphurous acid; but this is only partially right—in fact, in experiments performed for the purpose I always find that a trace of sulphuric acid is formed, and that much more is formed in the presence of a large supply of oxygen, or in the presence of the lower oxides of nitrogen, which it will be seen further on may probably occur in coal-gas.

Sulphuretted hydrogen burns very easily, and the combustion is generally attended with the production of free sulphur if there is an imperfect access of air, or if the gas is eliminated in large volumes; but such a decomposition is hardly likely to occur in coal-gas.

The experiments were performed in Letheby's apparatus for the estimation of sulphur in gas. It was very convenient to apply the chemical examination intended to the products of combustion, and the object was not so much the estimation of the sulphur as to get a qualitative examination of the products of combustion. In these experiments 15 to 30 (generally 20) feet of gas were allowed to pass through the metre at the rate of 1½ hours to each foot of gas. The carbonising or decarbonising apparatus (as the case might be) was placed between the meter and the burner, and the products of combustion were mixed with vapour of ammonia, and, by a bent glass chimney, were conveyed into the ordinary large glass cylindrical receiver. In the preliminary experiments, the ammoniacal vapour, used to fix the volatile acid, was introduced just below the burner, with the intention that it should be drawn through the apparatus by the strong draught produced by the combustion. It will be seen that another arrangement had to be adopted, owing to an unforeseen reaction. Two fluid ounces of distilled water were introduced into the receiver to assist and determine the condensation of volatile products, and the whole was supplemented by a very long tube, which condensed and brought back into the cylinder all the combustible products. The total amount of the sulphur in the gas averaged 4·16 grains per 100 feet, determined by precipitating the products with chlorate of barium (Ba_2ClO_3) in a hot solution.

Having estimated the total sulphur, the object we had in view was now to estimate the amount of sulphur eliminated from the burner as SO_2, and for this purpose a volumetric solution of iodine was used, each 100 c.c. of which represented 0·2 grain of sulphur or 0·4 grain of sulphurous anhydride.

The first experiments were performed with an Argand burner, the ammonia being introduced into the centre of the flame by a tube; hardly any evidence of sulphites could be found in the receiver, owing to the production of lower oxides of nitrogen. An ordinary fish-tail burner was at this stage of the investigation substituted for the Argand burner, and the following were the results with a 21-candle gas:—

1. (10 feet) required 7 c.c. vol. sol. I.
2. (20 ,,) ,, 8 ,, ,,
3. (30 ,,) ,, 10 ,, ,,

When the products of combustion were acidulated with sulphuric acid previous to the estimation with the volumetric solution, indications were still there of the lower oxides of nitrogen, and, from the discordant results, it was self-evident that there was some cause of error. In fact, the diffusion of the ammoniacal gas was so rapid that part of its vapour was burnt at the expense of the flame under experiment. To remedy this, the ammoniacal gas was so arranged that it should enter the large glass cylinder just where the bent chimney conveying the products entered, so that the cylinder was always full of ammoniacal vapour, but there should not be any in the chimney, the draught being so strong that all the vapours are swept forward through the apparatus with some considerable impetus.

After this arrangement was effected, the experiments proceeded with considerable regularity as will be observed from the following figures:—

30 feet required 35·5 c.c. vol. sol. I.
30 ,, ,, 32·5 ,, ,,
30 ,, ,, 36·0 ,, ,,

showing an average of 11·5 c.c. of the volumetric solution of iodine as being neutralised by the products of combustion of 10 feet. This represents 0·023 of S to the 10 feet, or 0·23 of a grain of sulphur eliminated as sulphurous acid to the 100 feet.

The experiments were repeated, but the gas was decarbonised by passing it through the measured quantity of methylated spirit as detailed. At the conclusion of the experiments, the gas was found saturated with volatile hydrocarbons of the benzol series, and small quantities of hydrocarbons having a high boiling-point.

20 feet required 9·0 c.c. vol. sol. I.
20 ,, ,, 8·0 ,, ,,
20 ,, ,, 11·5 ,, ,,

Average of this gas, therefore, calculated to the 60 feet, only gave ·0095 grain of sulphur as given off in the form of sulphurous acid to each 10 feet.

To sum up these experiments as far as they have gone, we may state that one of the most important observations made consists in the fact that in a gas of a high illuminating power a very large proportion of the sulphur is eliminated as sulphurous acid, that in one of a low illuminating power a considerable portion will be eliminated as sulphuric acid. Another important phase of the combustion is that the ammonia, or such volatile compounds as aniline (if they exist in coal-gas), will be converted into nitrous acid or some of the other low oxides of nitrogen.

The products of the slow combustion of ammonia would seem to be nitrite of ammonia; and ammoniacal gas and oxygen, according to K. Kraut, is entirely converted in that gas by a spiral of platinum wire. It is also proba that some bisulphide of carbon is retained by some of the fluid used in these experiments. This might account for the low amount of sulphur found in the relative experiments, but not for the great discrepancy in the two series of estimations.

As regards the relative therapeutical effects of sulphuric *versus* sulphurous acids, it might be said that the ultimate results would be the same because the sulphurous acid becomes gradually converted into the higher oxide. This is only true to a very limited extent; in fact, the sulphuric acid vapours are much more local in their effects, whilst the sulphurous acid is diffused at once through the apartment, and may be perceived, by virtue of its irritating effects upon the lungs, in any part of the room. It is probable that in the storage of delicate goods they would be much more likely to be injured by the sulphurous acid, and, *ergo*, by the 20-candle gas, than from the emanations from 16-candle gas. I am of opinion, also, that there is more sulphide of carbon present in ordinary gas than is generally stated, and that it escapes all the ordinary processes of estimation. I must, however, reserve this point for another communication.

As regards the Letheby's apparatus, it seems capable of performing many experiments having an important and useful bearing. Its great recommendation is that it submits the gas to a combustion similar to that which takes place in its daily use, and that, if more perfect combustion of the sulphur took place upon burning the gas with spongy platinum, as in Valentine's process,[*] it would not give the information we require in these special investigations.

The experiments embodied in this paper are not put forward as by any means complete, but they may be viewed as pioneers of a style of investigating which must be attended with some novel results, and must repay the experimenter. The presence of ammonia in the gas will determine the elimination of the sulphur as sulphuric acid.

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[*] The best method for estimating the total amount of sulphur.

A SINGULAR CASE OF CORROSION OF A TIN TANK.

By S. P. SHARPLES.

In June, 1872, I received a letter from the Collins Company, of Collinsville, Conn., of which the following is an abstract:—

This company has a hotel building in this place, supplied with very good spring water, which is conducted through, say 100 feet of lead pipe, from the cement pipe main in the street, to a very large tank or reservoir on an upper floor in the hotel. From this tank water is distributed all over the house, through lead pipes. Water is continually running into the tank, and of course is freely drawn off to the various points. The tank is lined with what the plumber calls pure block-tin. We observe that the water deposits white streaks, at various levels, around on the lining. Enclosed we send you a specimen of the tin lining and the white deposits or powder.

A waste pipe, 9 feet long by 2 inches in diameter, is within the tank, and subject to the action of the water.

Is the white powder from lead or any corrosive metal?

Subsequently they forwarded me specimens of the water taken from the spring, from the place where the lead pipe discharged into the tank, and from the place where it was drawn for the use in the house.

The water taken directly from the spring was examined, and gave 5·3 parts inorganic matter, and 2·5 parts organic matter, to the 100,000 parts of water.

The inorganic portion was mainly carbonate of lime, with a little sulphate of lime and chloride of sodium. The specimens of water drawn from the lead pipes were entirely free from even traces of that metal. The white powder referred to was found to be oxide of tin, with a mere trace of iron. I accordingly reported that I did not think any harm would arise from the use of the water,—as the water was a pure one, and free from lead,—and that oxide of tin was not regarded as injurious.

On the 27th of March, 1874, the superintendent of the works again wrote as follows:—

"We enclose specimens of the lining of the tank which contained the water, the purity of which we were suspicious. We may be mistaken, but it does seem to us that the lining has been destroyed by the action of the water, in a most unusual manner. The tank lining has lasted only five years. There has been a free and ample circulation of fresh water constantly in use in the day time, at the hotel where our tank is located; and yet, for some cause unaccountable to us, the lining (which is block-tin) is perfectly riddled by corrosion, and must be replaced by a new one of some kind."

In answer to further inquiries on my part, he forwarded another specimen of the water, and a large piece of the lining of the tank, and further wrote:—

"The water is collected at the spring, in a sheltered and ventilated reservoir, with cement lining, and is conducted therefrom in a large cement pipe through our main streets. House pipes of lead are attached all along."

The water from the end of the pipe, where it discharged into the tank, was again analysed, with the following results:—

Inorganic matter, 4·20; organic matter, 0·80 parts, in 100,000. Was perfectly free from nitrates; and, as the analysis shows, was rather better than when first examined. The lining is commercial block-tin, containing less than 2 per cent of impurities.

Instances of corrosion of lead are not uncommon; but I have failed, so far as I have investigated, to find a case parallel to this. Professor Chandler,[*] in an article on the use of tin-lined lead pipe, says, in speaking of tin-lined lead pipe: "Waters which take up one to two tenths a grain per gallon from lead pipe are not perceptibly affected by remaining for considerable lengths of time in the tin-lined pipes." And in another place, Mr. Cassamajor[†] states that tin is slightly more electro-negative than lead; and that it at first starts of a feeble galvanic current, which serves to cover the lead with a coating of oxide, and then all action ceases.

Dr. Lankester[‡] states, in regard to the tin-lined lead pipes: "I have tested these pipes with great care, and have exposed them to the action of water of various kinds. In no case have I discovered in the water the slightest trace of lead or tin. I have submitted the pipes to the action of distilled water, Thames water, water from artesian wells in London, and to water highly charged with organic matter; and in no case, where these waters have been exposed to the usual reagents for detecting the presence of tin or lead, has the slightest quantity of these metals been detected."

Field[||] states that tin does not oxidise at ordinary temperatures in the air, and but very slightly in water, retaining its metallic lustre for a long time; and, again, it is not sensibly affected by the combined presence of air and moisture.

This extensive corrosion of the metal seems, therefore, to be a hitherto unrecorded circumstances, tin being generally regarded as the least liable to change of all our common metals. The metal, as will be seen, is entirely eaten through in some places.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—In Chemical News, vol. xxix., p. 285, a suggestion is made by "Equivalent" which no rational Fellow of the

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[*] *Am. Chem.*, vol. ii., p. 251.

[†] *Ibid.*, vol. i., p. 3.

[‡] *Ibid.*, vol. ii., p. 27.

[||] "Watts' Dictionary," vol. v., pp. 803-4.

Chemical Society can approve of. The abstracts of papers from foreign sources now form the most valuable feature in the Journal, and have more than doubled its value; and no one can grudge the increase in price consequent on this most important improvement.

"Equivalent" thinks that practical papers should be more encouraged than they are. I venture to say that a too great partiality is already shown to so-called practical papers, while theoretical research is suppressed and discouraged. While a paper made up of analyses of some impure substances or mixtures, which the author may have succeeded in producing for the first time on record, is almost certain of publication in the Chemical Society's Journal, the publishing committee show a most unjust and unwarrantable reluctance to publish theoretical papers read before the Society. Excepting the leader of chemistry in Britain, and one or two older chemists now on the wane, theoretical chemistry has no supporters or representatives iu England.

By calling the attention of sensible men to the points on which "Equivalent" offers such valuable suggestions, his letter may prove not as useless as it would at first appear. —I am, &c.,

M. L.

Charlton, May 28, 1874.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—Allow me, as a country Fellow of the Chemical Society, to protest against "Equivalent's" proposal to return to the old style of quarterly reports without abstracts. I feel sure that I shall express the feeling of most provincial members, when I say that the admirable Journal is one of the chief inducements to me to remain a member of a society the meetings of which I am never able to attend; and though, in London, where access to foreign journals is comparatively easy, a chemist might do without such a help, in the country it has become almost indispensable.—I am, &c.,

H. R. P.

CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

To the Editor of the Chemical News.

Sir,—I have to answer the remarks of Mr. Ogilvie under the disadvantage of rural seclusion; therefore he will pardon me if I do not refer to many printed anthorities in substantiation of my remarks.

(2.) Under this paragraph Mr. Ogilvie fails to perceive the point of my reference to the term "fibrin or syntonine;" I think it will appear that my remarks were not irrelevant when I say that syntonine is the form of albumin which is obtained from muscle residue by the action of dilute acid, and not the residue left after treatment with water, alcohol, ether, &c.; in substantiation I refer to Thudichum's "Chemical Physiology," page 36, where he says "This (syntonine) is the name of the solid part of the flesh tissues, the particular fibrine of flesh of Liebig, which, insoluble in water, can be extracted from the insoluble part of meat by dilute acids in large quantities;" in fact, we may consider syntonine to hold a similar relationship to insoluble meat residues as gelatin does to osseine, *i.e.*, they are both formed by the processes used for the extraction.

(3.) I still hold that there is no justification for the statement that "fat is not only indispensable &c.," for Mr. Ogilvie says in his original paper, which I have not at hand, something to the effect that the fat present in the mutton is necessary for the repair of tissue. I do not say fat should be absent from our diet, but I hold that it is not absolutely necessary, for many of the herbivora take but an infinitesimal portion in their food, but they convert starch and sugar to fat.

I hold, then, that it is not necessary, though advantageous, to ingest fat. The extract (*d*), quoted from Lehman's "Physiological Chemistry," is rather out of date now, and does not support Mr. Ogilvie, because it states "We cannot *believe* that fat is a mere incidental agent in all these processes, but we must *rather* regard it as of essential aid, &c." (the Italics are mine).

This doubting condition shows Lehman to have been uncertain of the truth of the statement, and does not say a word about it being necessary to ingest fat, therefore the fat for this purpose could have been formed afterwards from starchy bodies. Dr. Thudichum says (Chem. Physiol., p 45)—"Fat in tissue may originate in several ways; it may have been eaten with the food, and after absorption have only been carried to the cells; or it may be formed from sugar dextrine, and glykogen; or lastly, it may owe its existence to the decomposition of albumen."

(6.) In this paragraph Mr. Ogilvie thinks that he has not fallen into error in comparing creatin with caffeine. I admitted in my former letter that chemically they had a resemblance, but what I objected to was, that creatin had been compared with caffeine in its physiological action: it has no parallel; the one is an alkaloid of an active nature, the other a poison which has to be got out of the system as quickly as possible, and therefore it is indeed a great error to state that it is useful as a stimulant in meat extract.

(7.) I do not think that experiments with the individual constituents of a composition always yield satisfactory results; nevertheless they should not remain untested; but Mr. Ogilvie thinks that my advocacy of Bogoslowsky's experiments puts me in opposition to "nearly the entire medical faculty;" it must be remembered that the medical faculty as an entire body gains its views of these substances, not from the individual experimental experience of its members, but from the few who choose to devote their time to the elucidation of natural phenomena.

Now there are many who have advocated the extract of meat as beneficial, and many who have condemned it, but these are few compared with the large number who make up the faculty and follow a leader.

In the capacity of medical officer to an asylum containing 2000 patients, I have had rare opportunities for making the "long-continued" observations, which, by the way, I consider to be more empirical than laboratory experiments; and I have decided to give preference to a beef-tea freshly prepared from fresh beef, rather than to an extractive carnis of the kind under discussion.

The argument adduced by Mr. Ogilvie respecting the difference in physiological results between large and small doses of poisons is not apt: he compares urea, creatin, &c., to alcohol and caffeine, two known stimulant poisons, and says it is irrelevant to the subject to speak of their action when in excess; I, however, only referred to the action of lactic acid in excess.

I may perhaps be allowed to compare urea and creatin to lead, a cumulative poison which in continued small doses produces decided symptoms, as will urea. It is well known that urea and creatin do not undergo decomposition in the body, but pass out unchanged after injection or ingestion; but alcohol and caffeine are consumed, particularly the latter, as I hope to show conclusively in some experiments shortly to be published; therefore, although small doses of alcohol and caffeine are oftentimes useful, small doses of urea or creatin must always be injurious. I fear the poorer classes in England have not yet found out how they may be benefited by the use of a cheap preserved meat: essentially abominable cooks, they have not succeeded in making palatable dishes, and are necessarily prejudiced against it, a condition of things to be deplored.

I regret Mr. Ogilvie should think my remarks unfounded and hypercritical, because it was my intention only to discuss with him the points at issue, which I think is one of the most advantageous methods of obtaining the opinion of another, and not to raise harsh strictures.—I am, &c.,

S. W. Moore.

Dover, June 20, 1874.

PRELIMINARY NOTICE.

To the Editor of the Chemical News.

Sir,—I have obtained the sulphur, chlorine, bromine, iodine, arsenic, some of the selenium and tellurium compounds, analogous to the nitro-prussides. A detailed paper will be published soon in the Chemical News.—I am, &c.,

T. D. Cuthill.

Hornsey Road, Holloway,
July 1, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 11, 1874.

Interior Distribution of Magnetism in a Bundle of Several Plates.—M. Jamin.—The author studies the case of a bundle decomposed and recomposed, then a bundle formed of saturated plates. *En resumé*, (1) All the plates have the same magnetism, m. (2) The magnetism, M, of the bundle is equal to those of the plates, $M = mn$. (3) If n is small each plate keeps the magnetism which it had. (4) If n exceeds a certain number the surfaces are saturated; M reaches a constant limit, m decreases. (5) The limit of M depends only on the extent of the surfaces of the magnet.

General Ideas on the Mechanical Interpretation of the Physical and Chemical Properties of Bodies.—M. Ledieu.—The author's object is, methodically, to develop the hypothesis of atomic vibrations; deducing from them the laws of heat, and the new principles of thermo-dynamics and thermo-chemistry. The paper is hardly suited for abstraction.

Permanence of Intensity of the Sun's Calorific Radiation.—M. Duponchel.—(Extract from memoir) One cannot allow a complete diffusion of movement tending to bring the molecules of the universe to a final state of uniform vibration. As there are centres of diffusion, there must also be centres of concentration, and all tends to show that these centres are the same; that, in particular, there is not loss of *vis viva* in the solar radiation but circulation—a closed circuit bringing back to starting-point the *vis viva* emitted. There cannot be a point of vibration forcing the ether out from it without an attraction of ether to fill the vacuum that tends to be produced. This conclusion is supported by various facts in physics. It is deducible from the readily ascertained truth, that the *vis viva* feeding the solar flux is really very small. The author cites as an incontestable proof the frigorific effect which the passage of Jupiter at the perihelion, coinciding with the periodic return of the solar spots, has on the temperature of the photosphere. When a planet passes the perihelion, it acquires an excess of *vis viva* of translation, which must be compensated by an equivalent loss of *vis viva* at other points. This temporary gain by the planet can come only from three sources—the internal *vis viva* or calorific force of the planet; the similar calorific force of the sun; and, lastly, the movement of translation of the sun and all the planets in space. The last is doubtless the most important, but the two others co-operate. In other terms, the planet then acts as a brake retarding the proper motion of the sun, but at the same time it draws upon its own heat; a cooling limited to its atmosphere and its solid surface, which induces temporary absorption of the calorific flux sent out from the sun. But this last absorption is necessarily limited to a fraction, greater or less, of the flux perceived during the period of absorption, equal to a fourth of the total revolution. For Jupiter, in particular, the total quantity of heat thus derived is, then, inferior to what the planet receives in two years and eight months; a quantity nearly equal to what the surface of the sun emits in one-sixth of a second. A fraction of this small quantity, absorbed in perihelion, restored in aphelion, produces, then, a very considerable calorific effect in the calorific state of the photosphere, the total force of which, referred to the intensity of the current, cannot therefore be figured either by thousands of centuries, or by years, but by minutes, and perhaps by seconds or fractions of a second. This frigorific effect occurs with all the planets, and, in the case of our earth in particular, it may explain the well ascertained inferiority of temperature of the Southern Hemisphere, the summer of which coincides precisely with the solstice of the perihelion.

Memoir on the Determination of True Simple Bodies by the Actions of Battery Currents in the Voltameter.—M. Martin.—(Extract) The author thinks he is able to demonstrate—(1) That the two electricities are not forces but imponderable bodies, having powerful and different chemical affinities, and that they do not act as physical forces, but, through a double chemical action, on the elements of water, transforming them into gas. (2) That water does not contain, as commonly supposed, two condensed gases which have only to be dissociated to be reproduced, but that the simple bodies H and O are its elements. (3) That the two gases whose combination produces water are compound bodies, formed by the chemical unison of the simple body oxygen with positive electricity, and the union of simple hydrogen with negative electricity, the combination of these gases giving two binary bodies, water and caloric. (4) That the currents of the battery do not pass through the acidulated liquids, and do not cause transport of elements, but that the two electricities simply reach the electrodes, and these unite with the elements of water, transforming them into hydrogen at the negative pole, and oxygen at the positive. M. Martin calls the negative electricity *electrile*, with the symbol El; and the positive electricity *etherile*, with Et for symbol. The formulæ of the two combined gases are thus HEl for hydrogen, and OEt for oxygen. He applies his theory to various electrical phenomena.

Mechanical Employment of Heat.—M. West.—(Extract from memoir). The author finds that the theoretical return for fuel in an air engine is superior to the return in certain steam engines in the proportion of 4·41 to 1. Hence the replacing of steam by air may be only partial, and yet present considerable advantages.

Study on the Properties of Explosive Substances.—M. Abel.—(Conclusion of third memoir

Absolute Magnetic Declinations Observed on the Coast of the Adriatic Sea.—M. Diamilla Miller.—The author here compares the calculated results with those of observation, and finds close agreement. He has been authorised by the Italian Minister of Marine to construct maps of the isogonal lines of Italian seas.

Observations Relative to the Memoir of MM. Crocé Spinelli and Sivel on their Ascent of March 22, 1874.—M. Lantique.—The author finds his own observations, with regard to the mistral, &c., confirmed.

Albumenoid Bodies.—M. A. Commaille.—The author has all along denied that the albumenoids could be regarded as protein, or any other single substance associated with bases or salts. Along with Millon he has shown—as is admitted by Berzelius, Quevenne, &c.—that milk contains two caseins and an albumen, which he has named *lactalbumen*; and also another principle which, in conjunction with Millon, he has named *lactoprotein*. Is not this the *galactozymase* of Béchamp? The author has always been of opinion that lactoprotein plays an important part in the spontaneous coagulation of milk. He has shown (*Moniteur Scientifique*, 1866, p. 897) that the albumenoids do not all combine with the same weight of platinum, which—as well as the rotatory power—may prove that they are specifically distinct. The platinic compounds tend to show that the albumens of animal origin take up, in general, more metal than those extracted from vegetables. Physiologically speaking, it is important to know that the albumen of milk, and that of the liquid of ascites, are no other than the albumen of blood-serum (Pt=8·50 per cent) not having undergone any modification. This identity has been already admitted by Hoppe-Seyler. In the blood itself the fibrin is merely albumen dissolved in serum, having taken another form, whilst the albumen of the red globules departs from this standard, and approximates closely to the albumen dissolved in the liquid which moistens the cerebral substance and the muscles, and furnishes the albumen of pathological urines. (Pt=10·50 to 11 per cent.) Vitelline resembles coagulated white of egg (Pt=8 per cent) whilst the casein of milk approaches certain principles abundantly diffused in the vegetable world, and known as vegetable casein (Pt=6·50 per cent), almondin, fibrin of gluten, &c. The author, along with Millon, regards the albumenoids as quaternary bodies, which may be represented as amids of leucin (capronamic acid) and of tyrosin; which is, according to him, the amide of Gerhardt's acetobenzoic acid, $C_{18}H_{11}O_6N$, a homologue of anisamic acid, $C_{16}H_9O_6N$.

Theory of the Formation of Nitre in Peru.—Antony Guyard. The author supposes that there have been sulphuric, hydrochloric, boric, nitric, and iodic epochs.

Coniferin; Artificial Formation of the Aromatic Principle of Vanilla.—F. Tiemann and W. Haarman.—(See p. 3).

Reimann's Farber Zeitung, No. 22, 1874.

Karan's Pigment.—This colour, offered to dyers at 15s. a pound, appears in two modifications. The one, warranted to dye a red on sixty times its weight of wool, consists of ground cochineal mixed with a preparation of tin and with oil of turpentine. The other variety, which is to supersede the aniline violets, is solid extract of logwood, pulverised, and mixed with a black powder, probably wood charcoal. It yields the well known flat logwood purple. Both these preparations are, of course, far from being worth the price at which they are offered.

Receipts follow for a black on cotton-wool; a red with artificial alizarin on cotton; a yellow on garments (cotton warps); directions for destroying the cotton in mixed rags; for dyeing woollen and mixed doubles; for dyeing woollen piece goods black, with a white list; for printing aniline colours on wool; and for dyeing woollen yarns a reddish drap.

Davy's Artificial Ivory.—This substance, being made by the action of a mixture of sulphuric and nitric acids upon cotton and linen rags, must consist in part of nitrocellulose, better known as gun-cotton. Articles made of it may, therefore, prove dangerous under a variety of possible circumstances.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, April 13, 1874.

Guanovulit—a New Mineral Found in the Birds' Eggs of Peruvian Guano.—F. Wibel.—The eggs in question belong to the genera *Aptenodytes, Pelecanus, Carbo*, &c. One of these contained a splendid crystalline body of a yellowish white colour and silky lustre. Its hardness is 2, its sp. gr. 2·33 to 2·65. It dissolves in water, forming a yellowish saline liquid, and leaving a slight residue. Dried at 100° it gave—

Loss on ignition	36·10
Deduct—	
Sulphuric acid =	24·08
Water, ammonia, and sal-ammoniac =	10·91
	34·92
Remains—	
Organic matter	1·11
Insoluble matter	0·26
Chlorine	0·58
Total sulphuric acid (SO_3)	48·43
Potash	34·76
Ammonia	3·46
Lime, phosphoric acid, soda, &c.	1·33

Excluding impurities we obtain the following composition

Water	9·82
Sulphuric acid (SO_3)	49·60
Potash	34·27
Ammonia	5·42
	99·11

agreeing with the formula—

$$(H_4N)_2SO_4 + 2K_2SO_4 + 3KHSO_4 + 4aq.$$

Of known minerals it approaches most closely to the lecontite of Taylor, and the guanapite of Shephard.

New Method of Formation of Diphenylen Oxide.—C. Graebe.—Kekulé has shown that the lead compound of phenyl-sulph-hydrate when heated yields sulphophenyl and sulphide of lead. The behaviour of phenol lead, under the same circumstances, has been examined by the author, who thus obtained diphenylen oxide, and a small quantity of a body not yet examined.

Action of Lead Oxide on Phenol at Elevated Temperatures.—Arno Behr and W. A. van Dorp.—Phenol conducted over oxide of lead, moderately heated, yields a distillate, which on treatment with potash yields a solid body. On extraction with alcohol and cooling they obtained crystalline leaflets, which are best purified by redistillation in watery vapour, in which they volatilise. They exhibit all the properties of diphenylen oxide.

Dibrom- and Dioxy-malonic Acids.—W. Petrieff.—The author has investigated the formation of bibrommalonic acid, and examined its ammonia, silver, lime, and baryta salts.

Promiscuous Communications from the Laboratory of the London Institution.—H. E. Armstrong.—These comprise the preparation of the haloid derivatives of the nitrophenol-sulphonic acids; the production of bromphenol from bromanilin; notes on the cresol of coal-tar; on the action of formiate of soda on the benzol-disulphonate of potash; and on the naphthyl sulphides.

Remarkable Occurrence of Humic Acid.—Th. Lettenmayer and C. Liebermann.—A piece of beech-wood was found covered with a black brittle layer of resin. This was easily soluble in cold water, the solution having an alkaline reaction. On the addition of a mineral acid an organic acid was deposited in rust-coloured flakes, containing a trace of nitrogen, 53·6 per cent of carbon, and 4·9 per cent of hydrogen.

Addition-Products of Hypochlorous Acid with the Allyl Compounds.—Louis Henry.—Not adapted for abstraction.

Conversion of Dinitro-benzol into Dibrom-benzol.—C. Wurster and U. Grubenmann.—The title of this paper gives a sufficient idea of its contents.

Azo Compounds.—W. Michler.—The compounds examined are biazoxy-benzoic acid and nitro-biazoxy-benzoic acid, with its behaviour in contact with tin and hydrochloric acid, and isobiazoxy-benzoic acid.

Æthyl-nitrolic Acid.—V. Meyer.—The author describes the formation of this acid, its preparation, its salts, its behaviour when heated, when treated with nascent hydrogen, and with sulphuric acid.

"In Defence."—J. Moritz.—Under this singular title we find a controversial note referring to Brefeld's paper, *Berichte*, vii., No. 5.

Nitro-oxysulpho-benzidanilid and Diamido-oxysulpho-benzid.—J. Annaheim.—The former compound consists of—

Carbon	58·77
Hydrogen	3·67
Nitrogen	11·42
Sulphur	6·53
Oxygen	19·59

It crystallises from solution in aniline in splendid red orthorhombic prismatic crystals (∞P,OP), and is permanent, *per se*; but if boiled with water, alcohol, ether, or benzol it decomposes with separation of aniline. The author has examined the hydriodate, hydrochlorate, and sulphate of the latter body. He mentions a peculiar behaviour of the amid compound with nitrous acid. If the hydrochlorate or the sulphate, in an acidified aqueous solution, is treated with nitrite of potash the liquid turns reddish, and a splendid scarlet body is deposited, soluble in ammonia with a deep red colour, and re-precipitable by acids. It deflagrates if heated.

On Orcin.—P. Weselsky.—Reserved for insertion in full.

On Phloroglucin.—R. Benedikt.—The action of nitrous acid upon phloroglucin does not lead, or at least not invariably, to nitrogenous compounds, as is the case with orcin and resorcin, but there is formed a non-nitrogenous dark brown colouring matter with a green metallic lustre, soluble in alkalies and ammonia with an intense colour. Its composition agrees with the formula $C_{12}H_8O_5$. The author gives it the name phlorein.

On Bixin.—Carl Etti.—A mere preliminary announcement.

Synthesis of Dicyan-diamidin.—E. Baumann.—A salt of guanidin is fused with urea, and heated for a short time. When cold the mass is dissolved in water, when dicyan-diamidin is found in the solution.

Communications from the Greifswold Laboratory.—H. Limpricht.—These communications refer to meta-toluidin, several of the salts of which have been examined; meta-brom-ortho-sulpho-toluylic acid with its salts; nitro-meta-brom-ortho-sulpho-toluylic acid and its salts; and the nitro-diazo compounds.

Multiples in the Chemical Development of Heat.—Julius Thomsen.—The author shows that analogous chemical processes are accompanied by developments of heat, which are either multiples of common constants, or whose differences are found to be such multiples.

Communications from the Laboratory of Gottingen University.—H. Hübner.—Notices of the iodo-nitrophenols, of isomeric benzo-nitranilids and their different behaviour with nitrogen, and of toluylen-diamin-sulpho acid and its salts.

Itaconic, Citraconic, and Mesaconic Acids.—G. A. Barbaglia.—By treating itaconic acid with anhydrous hydrocyanic acid the author forms the acids above-mentioned.

Action of Chlorine upon Aceton.—G. A. Barbaglia.—The author obtained in this manner both mono-chlor-aceton and dichlor-aceton.

Correspondence from Lund.—C. W. Blomstrand.—E. Berglund has examined the double salts of sulphurous acid, especially the cobalti-sulphites. A. Atterberg has published a dissertation on the glucinium compounds. Nordenskiöld has investigated the crystalline forms of cerite. O. Pettersson has examined the molecular volumes of certain series of isomorphous salts. O. N. Pahl has been engaged with the pyrophosphates. A. Morblad describes apparatus for the production of constant and prolonged currents of gases, and a syphon giving a constant current.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in evaporating and concentrating solutions of caustic soda, potash, and their salts, acid liquors occurring in the manufacture of oxalic acid, and also gelatine. Richard Samuel Dale and John Dale, chemists, Manchester. October 2, 1873.—No. 3191. In the manufacture of caustic soda, caustic potash, or mixtures of the same and other substances, from the solutions of which salts are deposited in their evaporation and concentration, much wear and tear of plant and loss of time is entailed by the process now usually carried on. Ordinary steam-boilers or other suitable vessels are used, from which the steam produced in the evaporation shall be rapidly conducted away by means of vacuum-pumps or other suitable means for producing a vacuum. These boilers may either be heated with fire or steam, but the latter is preferred, and is supplied by means of a series of tubes in connection with a large steam-chest placed inside the boiler or vessel used for the evaporation. The above mode of treatment is found especially applicable and advantageous in the manufacture of oxalic acid, where the solutions of the acid require to be kept at a low temperature to provide against decomposition; but in this case it is necessary that the process must be carried on in leaden vessels. This process will also be found most advantageous in the manufacture of glue and size (which it is absolutely requisite should be maintained at a low temperature during concentration), as also in the evaporation and concentration of the chlorides of sodium and potassium and other salts of the same.

A new or improved mode of cleaning or purifying and sweetening butter scrappings and rancid or decayed butter. William McDonnell and Charles McDonnell, Limerick, Ireland. October 6, 1873.—No. 3233. According to this invention, dirty butter or butter "scrappings" are melted and churned with milk or butter-milk, whereby the original qualities are recovered.

Improvements in metallic alloys. Henry Hahn, Lombard Street, London. (A communication from Jacob Ernst Jacoby, Hamburg-on-the-Heights, Germany). October 7, 1873.—No. 3246. This invention has for its object improvements in the composition of metallic alloys applicable to various useful purposes, such as reducing friction in bearings and other parts of machinery, resisting oxidation, being also comparatively cheap and economical. Metallic alloys made according to this invention consist of from 70 to 73 per cent of copper, from 9 to 11 per cent of tin, from 15 to 20 per cent of lead, and from 0·05 to 1 per cent of zinc.

Improvements in the treatment and compounding of cast-iron with other metals or materials containing such metals while in a molten state. George Gordon de Luna Byron, Chancery Lane, Middlesex. (A communication from William Mernorice Arnold, New York). October 7, 1873.—No. 3247. The alloying of cast-iron in its molten state with copper, tin, zinc, manganese, and antimony. The compound metals are melted in a crucible, and mixed with the cast-iron, removing the oxides, sulphur, and phosphorus, and reducing the carbon, electrophying and galvanising the iron in a molten state. The best proportions for common grey iron are as follows:—Copper, one (1) pound; tin, one-half (½) pound; zinc, three (3) pounds; manganese, one-quarter (¼) pound; antimony, for hardening without chilling, from ¼ to ½ pound to each hundred pounds of iron.

Improvements in apparatus for the manufacture of chlorine. Henry Deacon, Appleton House, Widnes, Lancaster. October 7, 1873.—No. 3253. In the production of chlorine by means of heated hydrochloric acid and of atmospheric air, brought into contact at an elevated temperature with what I have termed a decomposing material, viz., porous brick, clay, or other inert matter, impregnated with sulphate of copper or with a mixture of sulphate of copper and sulphate of soda or otherwise, a further amount of heat is emitted during such decomposition, and the object of this invention is to utilise and make available this emitted heat in assisting the preliminary heating of the gases.

Improvements in the manufacture of iron and steel. Stanislas Louis Delalot, chemist, Southampton Buildings, Holborn, Middlesex. October 9, 1873.—No. 3265. The features of novelty of this invention consist in mixing nickel or cobalt, or a mixture of both, with iron or steel in certain proportions, by which it is rendered proof against rust by exposure to the atmosphere, water, or other oxidising influences. Cast-iron thus treated can be converted into wrought-iron and steel by the usual methods, and is equal in quality to iron and steel as heretofore manufactured.

NOTES AND QUERIES.

Recovered Animal and Vegetable Oils and Grease.—Can you or any of your valued correspondents kindly inform me, through the medium of the Chemical News, how to bleach and refine recovered animal and vegetable oils and grease, also the stearine produced from the same? Having a large quantity on hand, I shall be very much obliged for this information.—An Oil-Refiner.

TO CORRESPONDENTS.

W. B.—Your query is only suitable for our advertisement pages.

THE CHEMICAL NEWS.

Vol. XXX. No. 763.

THE COMMITTEE ON ADULTERATION.

In returning to the consideration of the statements made before this Committee, we must remind our readers that the Adulteration Act, as at present in force, requires that public analysts should possess "sufficient medical, chemical, and microscopical knowledge." Partly in consequence of this stipulation, and partly from the old superstition still prevalent in England, that chemistry has some especial and exclusive connection with the healing art, not a few of the analysts appointed under the Act are practising medical men. The gentlemen examined before the Committee were asked whether, in their opinion, medical knowledge was a necessary qualification for a public analyst. With the exception of Dr. Tidy all replied in the negative. We quite agree with the majority. No amount of medical—as distinct from chemical—knowledge can render the slightest aid in the essential part of an analyst's duty, the detection of adulterations in articles of food. When impurities are discovered a second question may certainly arise as to their probable effect upon public health; but on this subject sound information has been so widely circulated that every professional chemist, nay, almost every man of decent education, can give a satisfactory answer. We are perfectly aware that many of the most eminent chemists have been originally educated for the medical profession. But how any one man can be, at the same time, a successful medical practitioner and a trustworthy chemical analyst, we are unable to see. For the most gifted of us there are only twenty-four hours in the day. If a division of labour is found essential in ordinary trades, is it less necessary in case of professions which make such vast and continually growing demands upon time and attention? Nay, it might be argued that the habits of thought developed by the practice of medicine are not precisely those which lead to success in the rigorously exact sphere of chemical research. Hence, far from demanding "medical" knowledge from the public analyst, we should think an actually practising medical man disqualified for such a position.

The number of disputed cases which have come before the courts, and have given rise to some amount of profane comment in non-professional journals, naturally led to the question of a reference whose decision should be final. But when we heard the Inland Revenue Laboratory at Somerset House suggested as the ultimate court of appeal we were disposed to think that the proposal was a joke intended for the columns of one of our comic contemporaries. Among the public analysts, and among those chemists who might be called to give evidence in defence of an accused person, there are men who have won a world-wide reputation by years of laborious and successful research. We fully endorse the statement that such men are more fit to revise the results of the Somerset House Laboratory than to bow to its decisions. As far as we can judge the award of the Revenue analysts would not be accepted by any first-rate chemist.

We feel certain that Dr. Voelcker would protest if his analysis of a sample of coprolites or superphosphate were to be rejected as inaccurate and overruled on such authority.

We feel bound to add that we see no reason for supposing that this most unhappy and ill-judged scheme has emanated from the Inland Revenue chemists, or has even received their sanction, and we cannot help sympathising with them on the embarrassing position in which they have found themselves so unexpectedly placed.

We have already made mention of Mr. Allen's rival—and infinitely more practical—project. This gentleman proposes the formation of an independent body of referees, to be elected annually by the public analysts themselves. On the details of this scheme considerable variety of opinion may prevail. But we think it deserving of support because it is—or rather it would be—the first formal and official step towards the definite professional organisation of analytical and consulting chemists. We have, from time to time, pointed out the necessity for such an organisation. We believe it is demanded alike in the interests of the public and of chemists themselves. It is needful, on the one hand, to exclude incompetent and dishonourable men, and on the other to raise and defend the *status* of the profession, and prevent its legitimate sphere from being encroached upon by outsiders. But such an organisation must, as in the analogous cases of the Pharmaceutical Society, of the Institute of Civil Engineers, the Royal College of Surgeons, &c., come from within. The Analytical and Consulting Chemists of England must win the right of deciding who shall be admitted into their body, who shall have the right of practising, and whom they will recognise as duly qualified. To so desirable a consummation we believe that Mr. Allen's suggestion may be made to serve as the first step, and we therefore would beg, on its behalf, the especial consideration of our readers. It obviously contains not merely a provision for deciding disputed cases, but a key to another difficulty with which the Committee was to some extent engaged, and to which it will be our duty to return,—namely, the appointment of the public analysts themselves.

We are not about to come forward as the general and indiscriminating advocate of these gentlemen. Class laudations are no less injudicious than class censures. Like other bodies of men, however selected and appointed, they vary in competence for the duties they have undertaken. But who—especially in case of a novelty like the working of the Adulteration Act—could expect anything else? The public analysts have undertaken a task far from easy; they have been but very sparingly supported by public opinion, and have been keenly scrutinised by parties interested in fraudulent practices.

The question as to what constitutes adulteration, and what therefore should meet with repression and punishment, seems still open. If we might venture to suggest, we would recommend a gradually increasing stringency. Let us first wage war against the grosser evils, and as they become rarer let us turn our attention to those of a less formidable character. Dishonest tradesmen have quietly and perseveringly educated the public palate down to "fortified" wines, and chicoried coffee, and farinised chocolate, and brilliantly green jams and pickles. We have got to reverse the process, and if we proceed too rashly we may not only lose the support of public opinion, but find it enlisted against us.

Why, we may here ask, should the law confine its attention to articles of diet? The man who sells us a blanket got up with a deliquescent salt, like chloride of magnesium, imperils our health just as decidedly as if he had put amylic or petroleum products in our wine, or red-lead in our chocolate. Is it just that he should altogether escape?

ON THE FORCES CAUSED BY EVAPORATION FROM AND CONDENSATION AT A SURFACE.*

By Prof. OSBORNE REYNOLDS, of Owens College, Manchester.

It has been noticed by several philosophers, and particularly by Mr. Crookes, that, under certain circumstances, hot bodies appear to repel and cold ones to attract other bodies. It is my object in this paper to point out and to describe experiments to prove that these effects are the results of evaporation and condensation; and that they are valuable evidence of the truth of the kinetic theory of gas, viz., that gas consists of separate molecules moving at great velocities.

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* A Paper read before the Royal Society, June 18, 1874.

The experiments of which the explanation will be given were as follows:—

A light stem of glass, with pith-balls on its ends, was suspended by a silk thread in a glass flask, so that the balls were nearly at the same level. Some water was then put in the flask, and boiled until all the air was driven out of the flask, which was then corked and allowed to cool. When cold there was a partial vacuum in it, the gauge showing from ½ to ¾ of an inch pressure.

It was now found that when the flame of a lamp was brought near to the flask, the pith-ball which was nearest the flame was driven away, and that with a piece of ice the pith was attracted.

This experiment was repeated under a variety of circumstances, in different flasks and with different balances, the stem being sometimes of glass and sometimes of platinum: the results, however, were the same in all cases, except such variations as I am about to describe.

The pith-balls were more sensitive to the heat and cold when the flask was cold and the tension within it low, but the effect was perceptible until the gauge showed about an inch, and even after that the ice would attract the ball.

The reason why the repulsion from heat was not apparent at greater tensions was clearly due to the convective currents which the heat generated within the flask. When there was enough vapour these currents carried the pith with them; they were, in fact, then sufficient to overcome the forces which otherwise moved the pith. This was shown by the fact that when the bar was not quite level, so that one ball was higher than the other, the currents affected them in different degrees; also that a different effect could be produced by raising or lowering the position of the flame.

The condition of the pith also perceptibly affected the sensitiveness of the balls. When a piece of ice was placed against the side of the glass, the nearest of the pith-balls would be drawn towards the ice, and would eventually stop opposite to it. If allowed to remain in this condition for some time, the vapour would condense on the ball near the ice, while the other ball would become dry (this would be seen to be the case, and was also shown by the tipping of the balance, that ball against the ice gradually getting lower). It was then found, when the ice was removed, that the dry ball was insensible to the heat, or nearly so, while that ball which had been opposite to the ice was more than ordinarily sensitive.

If the flask were dry and the tension of the vapour reduced with the pump until the gauge showed ¾ of an inch, then, although purely steam, it was not in a saturated condition, and the pith-balls which were dry were no longer sensitive to the lamp, although they would still approach the ice.

From these last two facts it appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat.

In order that these results might be obtained, it was necessary that the vapour should be free from air. If a small quantity of air was present, although not enough to appear in the gauge, the effects rapidly diminished, particularly that of the ice, until the convection currents had it all their own way. This agrees with the fact that the presence of a small quantity of air in steam greatly retards condensation, and even evaporation.

With a dry flask and an air-vacuum neither the lamp nor the ice produced their effects; the convection currents reigned supreme, even when the gauge was as low as ¼ inch. Under these circumstances the lamp generally attracted the balls and the ice repelled them,—*i.e.*, the currents carried them towards the lamp and from the ice; but by placing the lamp or ice very low the reverse effects could be obtained, which goes to prove that they were the effects of the currents of air.

These experiments appear to show that evaporation from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward. These effects admit of explanation, although not quite as simply as may at first sight appear.

It seems easy to conceive that when vapour is driven off from a body there must be a certain reaction or recoil on the part of the body; Hiero's engine acts on this principle. Or if a sheet of damp paper be held before the fire, from that side which is opposite to the fire, a stream of vapour will be drawn off towards the fire with a perceptible velocity, and therefore we can readily conceive that there must be a corresponding reaction, and that the paper will be forced back with a force equal to that which urges the vapour forwards. And, in a similar way, whenever condensation goes on at a surface it must diminish the pressure at the surface, and thus draw the surface forwards.

It is not, however, wholly, or even chiefly, such visible motions as these that afford an explanation of the phenomena just described. If the only forces were those which result from the perceptible motion they would be insensible, except when the heat on the surface was sufficiently intense to drive the vapour off with considerable velocity. This, indeed, might be the case if vapour had no particles, and was what it appears to be—a homogeneous elastic medium; and if, in changing from liquid into gas, the expansion took place gradually, so that the only velocity acquired by the vapour was that necessary to allow its replacing that which it forces before it, and giving place to that which follows.

But, although it appears to have escaped notice so far, it follows as a direct consequence of the *kinetic* theory of gases that whenever evaporation takes place from the surface of a solid body or a liquid, it must be attended with a reactionary force equivalent to an increase of pressure on the surface, and which force is quite independent of the perceptible motion of the vapour. Also condensation must be attended with a force equivalent to a diminution of the gaseous pressure over the condensing surface, and likewise independent of the visible motion of the vapour. This may be shown to be the case as follows:—

According to the kinetic theory the molecules which constitute the gas are in rapid motion, and the pressure which the gas exerts against the bounding surfaces is due to the successive impulses of these molecules, whose course directs them against the surface, from which they rebound with unimpaired velocity. According to this theory, therefore, whenever a molecule of liquid leaves the surface, henceforth to become a molecule of gas, it must leave it with a velocity equal to that with which the other particles of gas rebound,—that is to say, instead of being just detached and quietly passing off into the gas, it must be shot off with a velocity greater than that of a cannon-ball. Whatever may be the nature of the forces which give it the velocity, and which consume the latent heat in doing so, it is certain, from the principle of conservation of momentum, that they must react on the surface with a force equal to that exerted on the molecule, just as the pressure of the powder on the breech is the same as on the shot.

The impulse on the surface, therefore, from each molecule which is driven off by evaporation must be equal to that caused by the rebound of one of the reflected molecules (supposing all the molecules to be of the same size),—that is to say, since the force of rebound will be equal to that of stopping, the impulse from a particle driven off by evaporation will be half the impulse received from the stopping and reflection of a particle of the gas. Thus the effect of evaporation will be to increase the number of impulses on the surface; and although each of the new impulses will only be half as effective as the ordinary ones, they will add to the pressure.

In the same way, whenever a molecule of gas comes up to a surface, and instead of rebounding is caught and retained by the surface, and is thus condensed into a molecule of liquid, the impulse which it will thus impart to the surface will only be one-half as great as if it had rebounded. Hence condensation will reduce the magnitude of some of the impulses, and therefore will reduce the pressure on the condensing surface.

For instance, if there were two surfaces in the same vapour, one of which was dry and the other evaporating, then the pressure would be greater on the moist surface than on that which was dry. And again, if one of the surfaces was dry and the other condensing, then the pressure would be greater on the dry surface than on that which was condensing. Hence, if the opposite sides of a pith-ball in vapour were in such different conditions, the ball would be forced towards the colder side.

These effects may be expressed more definitely as follows:—

Let v be the velocity with which the molecules of the vapour move,
p the pressure on a unit of surface,
d the weight of a unit of volume of the vapour,
w the weight of liquid evaporated or condensed in a second;

then the weight of vapour which actually strikes the unit of dry surface in a second will be—

$$= \frac{dv}{6};$$

and the pressure p will be given by—

$$p = 2\frac{dv^2}{6g};\ ^*$$

and f, the force arising from evaporation, will be given by—

$$f = \frac{wv}{g};$$

therefore—

$$f = w\sqrt{\frac{3p}{gd}}.$$

Thus we have an expression for the force in terms of the quantity of water evaporated and the ratio of the pressure to the density of the vapour. And if the heat necessary to evaporate the liquid (the latent heat) is known, we can find the force which would result from a given expenditure of heat.

Applying these results to steam, we find that at a temperature of 60° the evaporation of 1 lb. of water from a surface would be sufficient to maintain a force of 65 lbs. for one second.

It is also important to notice this force will be proportional to the square root of the absolute temperature, and consequently will be approximately constant between temperatures of 32° and 212°.

If we take mercury instead of water, we find that the force is only 6 lbs. instead of 65; but the latent heat of mercury is only $\frac{1}{8}$ that of water, so that the same expenditure of heat would maintain nearly three times as great a force.

It seems, therefore, that in this way we can give a satisfactory explanation of the experiments previously described. When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp; therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near, the temperature of the pith will be reduced, and it will condense the vapour and be drawn towards the ice.

It seems to me that the same explanation may be given of Mr. Crookes's experiments; for, although my experiments were made on water and at comparatively high pressures, they were in reality undertaken to verify the explanation as I have given it. I used water in the hope of finding (as I have found) that in a condensable vapour the results could be obtained with a greater density of vapour (with a much less perfect vacuum), the effect being a consequence of the saturated condition of the vapour rather than of the perfection of the vacuum.

Mr. Crookes only obtained his results when his vacuum was nearly as perfect as the Sprengel pump would make it. Up to this point he had nothing but the inverse effects, viz., attraction with heat and repulsion with cold. About the cause of these he seems to be doubtful; but I venture to think that they may be entirely explained by the expansion of the surrounding gas or vapour and the consequent convection currents. It must be remembered that whenever the air about a ball is expanded, and thus rendered lighter by heat, it will exercise less supporting or floating power on the ball, which will therefore tend to sink, which tendency will be in opposition to the lifting of the ascending current, and it will depend on the shape and thickness of the ball whether it will rise or fall when in an ascending current of heated gas.

The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum, was because he had then too large a proportion of air or non-condensing gas mixed with the vapour, which also was not in a state of saturation. In his experiments the condensable vapour was that of mercury, or something which required a still higher temperature, and it was necessary that the vacuum should be very perfect for such vapour to be anything like pure and in a saturated condition. As soon, however, as this state of perfection was reached, then the effects were more apparent than in the corresponding case of water. This agrees well with the explanation; for, as previously shown, the effect of mercury would for the same quantity of heat be three times as great as that of water; and besides this, the perfect state of the vacuum would allow the pith (or whatever the ball might be) to move much more freely than when in the vapour of water at a considerable tension.

Of course this reasoning is not confined to mercury and water; any gas which is condensed or absorbed by the balls when cold in greater quantities than when warm would give the same results; and as this property appears to belong to all gases, it is only a question of bringing the vacuum to the right degree of tension.

There was one fact connected with Mr. Crookes's experiments which, independently of the previous considerations, led me to the conclusion that the result was due to the heating of the pith, and was not a direct result of the radiated heat.

In one of the experiments exhibited at the *soirée* of the Royal Society, a candle was placed close to a flask containing a bar of pith suspended from the middle; at first the only thing to notice was that the pith was oscillating considerably under the action of the candle; each end of the bar alternately approached and receded, showing that the candle exercised an influence similar to that which might have been exercised by the torsion of the thread had this been stiff. After a few minutes' observation, however, it became evident that the oscillations continued instead of gradually diminishing, as one naturally expected them to do; and more than this, they actually increased until one end of the bar passed the light, after which it seemed quieter for a little, though the oscillations again increased until it again passed the light. As a great many people and lights were moving about, it seemed possible that this might be due to external disturbance, and so its full importance did not strike me. Afterwards, however, I saw that it was only to be explained on the ground of the force being connected with the temperature of the pith. During part of its swing one end of the pith must be increasing in temperature, and during the other part cooling. And it is easily seen that the ends will not be hottest when nearest the light, or coldest when farthest away; they will acquire heat for some time after they have begun to recede, and lose it after they have begun to approach. There will, in fact, be a certain lagging in the effect of the heat on the pith, like that which is apparent in the action of the sun on a comet, which causes the comet to be grandest after after it has passed its perihelion. From this cause it is easy to see that the mean temperature of the ends will be greater during the time they are retiring than while approaching, and hence the driving force on that end which is leaving will, on the whole, more than balance the retarding force on that which is approaching; and the result will be an acceleration, so that the bar will swing further each time until it passes the candle, after which the hot side of the bar will be opposite to the light, and will for a time tend to counteract its effect, so that the bar will for a time be quieter. This fact is independent evidence as to the nature of the force; and although it does not show it to be evaporation, it shows that it is force depending on the temperature of the pith, and that it is not a direct result of radiation from the candle.

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* See Maxwell's "Theory of Heat," p. 294.

Since writing the above paper, it has occurred to me that, according to the kinetic theory, a somewhat similar effect to that of evaporation must result whenever heat is communicated from a hot surface to gas.

The particles which impinge on the surface will rebound with a greater velocity than that with which they approached, and consequently the effect of the blow must be greater than it would have been had the surface been of the same temperature as the gas.

And in the same way whenever heat is communicated from a gas to a surface, the force on the surface will be less than it otherwise would be, for the particles will rebound with a less velocity than that at which they approach.

Mathematically the result may be expressed as follows:—The symbols having the same meaning as before, ϵ representing the energy communicated in the form of heat, and δv the alteration which the velocity of the molecule undergoes on impact. As before—

$$p = \frac{d}{3g} v^2 \text{ or } u = \sqrt{\frac{3gp}{d}};$$

and—

$$\epsilon = \frac{d \times v}{b} \left(\frac{(v + \delta v)^2 v^2}{2g} \right) = \frac{d \times v}{b} \frac{v \delta v}{g} \text{ nearly,}$$

$$f = 2 \frac{d \times v}{g} \times \delta v;$$

$$\therefore f = \frac{2\epsilon}{v} = 2\epsilon \sqrt{\frac{d}{3pg}}.$$

Therefore, in the case of steam at a temperature of 60—

$$f = 7\epsilon,$$

and in air—

$$f = 5\epsilon,$$

results which appear to be very large.

It must, however, be remembered that ϵ depends on the rate at which cold particles will come up to the hot surface, which is very slow when it depends only on the diffusion of the particles of the gas *inter se*, and the diffusion of the heat amongst them.

It will be much increased by convection currents, but these will (as has been already explained) to a certain extent produce an opposite effect. It would also seem that this action cannot have had much to do with Mr. Crookes's experiments, as one can hardly conceive that much heat could be communicated to the gas or vapour in such a perfect vacuum as that he obtained, unless indeed the rate of diffusion varies inversely as some high power of the density of a gas. It will be interesting, however, to see what light experiments will throw on the question.

ON SOME CHEMICAL ASPECTS OF PHYSICAL GEOGRAPHY.

By ALEX. S. WILSON, B.Sc.

I.

THE various departments of natural science are so closely related that no one of them can be studied altogether apart from the others; to become proficient, therefore, in any special science the student has not only to learn the principles of that science, but he has also to familiarise himself with those facts of other sciences which bear directly on his own studies. A result of this is that every advance, made in any science, is attended by a corresponding progression in the others. When a new fact is disclosed by scientific research we have not merely an addition to recorded observations, in a particular line of inquiry, but we are furnished with a means of investigating phenomena which form the subjects of other sciences.

Keeping this in mind, let us see what information may be gathered by reviewing, in the light of recent chemical research, some of the better-known operations of Nature. It is not our intention to enter on the wide field of chemical geology, nor is it desirable that we should, seeing that this subject has already received a considerable amount of attention. For the present we must be content to examine, by the aid of increased chemical knowledge, some of those processes which belong to that section of dynamical geology which treats of surface agencies, and, as being of most interest, we shall consider only those that are in any way concerned in determining the distribution of organised structures.

First, then, as to the chemical facts:—

It is well known that alumina and ferric oxide exercise a remarkable influence on certain salts in solution, but the explanation of the phenomenon is somewhat complicated. In the case of many salts it appears, from the experiments of Warington, that a decomposition takes place: thus, in the absorption of calcic phosphate by oxide of iron or alumina, from a carbonic acid solution, the phosphoric acid simply leaves the calcium and attaches itself to the iron or aluminium, forming ferric or aluminic phosphate. The behaviour of these oxides towards carbonates, sulphates, nitrates, and chlorides, is different; from solutions of these salts the oxides of iron and aluminium abstract the bases, whilst they reject in some measure the acids. In all these instances the absorption may be due to chemical affinity, but there are many examples of absorption which have not yet been resolved into chemical reactions, and which at present do not seem capable of being so resolved; there are circumstances, too, connected with this subject of absorption which still require an explanation. Moreover, some substances are absorbed in a manner quite at variance with our notions of what constitutes a chemical combination; the attraction for these would therefore appear to partake more of the nature of adhesion than of chemical force, and in this case what occurs may be analogous to that which happens when ether is mixed with a solution of potassic iodide from which the iodine has been liberated. The ether dissolves the iodine, forming a coloured solution, which separates, leaving the water clear; so, in the former case, we may regard the ferric oxide and alumina as dissolving a portion of the salt and then separating from the mixture, just as the ether does in the above illustration.

From this property arises the difficulty that is often experienced in washing precipitated oxides of iron, aluminium, and chromium, free from alkaline salts. Warington found that ferric hydrate, precipitated by potassic carbonate, only lost two-thirds of its potassium by a washing which should have reduced a perfectly soluble salt to $\frac{1}{13}$th of the original quantity. Similarly, he found that for ferric hydrate, precipitated by ammonia, every 100 grs. of anhydrous oxide retained 0·042 grs. NH_3, after being washed to an extent sufficient to have reduced it to $\frac{1}{100000}$th of the salt originally present. The same observer has published (*J. Chem. Soc.*, 1868) experiments showing the amounts of various salts absorbed by ferric oxide and alumina from solutions of a definite strength, but as the results are only true for this particular strength of solution more observations are required. From some experiments of my own I am led to believe that the proportion of salt absorbed depends greatly on the strength of the solution, and that it diminishes rapidly as the solution is diluted.

This absorptive power is not only exercised towards salt in solution, but gaseous substances are influenced by it as well. Advantage is taken of this in the well-known process for purifying coal-gas from ammonia and objectionable sulphur compounds, by means of ferric oxide. Nor is this all. Boussingault found that a kilogramme of each of the following substances, after being ignited, when exposed to the air for two or three days, absorbed the following quantities of ammonia:—Sand, 0·5 m.grm.; powdered brick, 0·5 m.grm.; powdered bone-ash, 0·84 m.grm. These quantities are so small, however (0·00005 per cent), that it is difficult to say whether they were absorbed from the air, or were formed in the pores of the substance, by the direct union of nitrogen and hydrogen, or even that they are not due to imperfections in the apparatus and method employed to estimate the ammonia.

Other compounds of iron and aluminium exercise, to some extent, this influence on salts in solution, and notably their various combinations with silicic acid, which enter so largely into the composition of soils and clays.

Most soils and clays being mixtures, a part of their absorptive power may be due to uncombined oxide of iron or alumina, but this is small compared with the total absorption. Many clays contain, in addition to certain alkaline silicates, soluble salts of the alkalies. These salts may have been produced by the decomposition of the alkaline silicates, existing in the rock from the disintegration of which the clay was formed; or the argillaceous particles may have abstracted them from the water, by the action of which they were reduced to their state of minute division. Salts of the fixed alkalies might get into clay by either of these ways, but the ammoniacal salts which are found existing in clays must either have had an organic origin or have been absorbed from water. The organic matter in clays is generally so finely divided, and since water has been the pulverising agent, every trace of ammoniacal salt would have been removed by the washing process to which every part had been subjected, had it not been for the retentive power of the clayey particles. On account of this property the addition of clay has been recommended as a means of removing small quantities of ammonia from waters intended for domestic use. Lake water may in some cases owe its purity to the subsiding sediment removing salts in this way; at any rate it is nearly certain that the waters of many rivers and wells have been purified in this manner. Lawes, Gilbert, and Way, found that rain-water contained nitrogen equivalent to 0·0837 grain per gallon of ammonia. Now this is a much greater quantity than exists in uncontaminated river-water. Frankland and Armstrong obtained, as an average of fifty samples of water collected from running streams, 0·008 in 100,000 parts, or 0·0056 gr. per gallon. How, then, has this water, falling as rain, been purified? Chemists have ascribed this reduction in the amount of ammonia which has taken place in the waters of rivers, lakes, and wells, to the action of plants, but it may be questioned if this cause is sufficient to account for its removal to such an extent. I am inclined to the opinion that the soil is largely concerned in its removal,—first, because such waters as we have been speaking of could only have remained in contact with the absorbing surfaces of plants for a short time; and if we take into account the vast body of water constantly making its way into river-beds, this time is too short to admit of the ammonia being withdrawn from every small portion of water flowing past; and secondly, because water coming in contact with much vegetable matter would be as likely to dissolve decaying nitrogenous substances as to have ammoniacal salts removed. If, then, whilst percolating through the soil, water be robbed of the substances it dissolved from the atmosphere, when falling as rain, may we not infer that the earthy *detritus*—borne down by rivers, and deposited on their banks and deltas—acts in the same way on the ammoniacal and other salts derived from the sewage and impurities with which rivers become charged as they proceed?

Experiment has shown that earthy matter absorbs a much larger proportion of salts from a strong solution than the same quantity of earthy matter does from a dilute solution. If, therefore, we were warranted in attributing the removal of ammonia from rain-water to the action of the soil, we cannot but conclude that the earthy matter, settling at the mouths of rivers, must carry down with it salts of potash, ammonia, and phosphoric acid, since a river is richer—as regards these substances—in its lower than in its upper course.

The mud of such a river as the Nile is rich in nitrogenous compounds, but the silt of our own rivers also contains ammonia, and that even when it appears to consist largely of coarse sand, and when one might have expected that all soluble salts would have been washed out. The investigations of Boussingault, and of Lawes, Gilbert, and Pugh, show, almost conclusively, that plants do not assimilate gaseous nitrogen, but that they derive nearly the whole of it from the soil as ammonia or nitric acid.

Schönbein suggested that ammonia might be formed by the evaporation taking place from the leaves, but there is no evidence that plants derive nitrogen from this source. Vegetation is therefore indebted for its nitrogenous—as for its mineral—constituents to the soil, and wherever these occur in considerable quantity one great condition of fertility is fulfilled. The presence, then, of substances so indispensable to the growth of plants, as salts of potash, ammonia, and phosphoric acid, must be an important factor in that rich and varied vegetable life for which river deltas and other alluvial districts are celebrated.

Agriculturists may consider phosphoric acid, in combination with iron or aluminium, too slow in its action to constitute a fertiliser; nevertheless, in the course of time, these inert phosphates do unquestionably exercise a favourable influence on the produce of any land, as the rich pasture-lands of Holland—the gift of the Rhine—or the abundant harvests of the Mississippi plains bear witness. Since, then, the luxuriant herbage of alluvial soils owes much of its necessary inorganic food to the absorbing action of earthy matter, this principle must, in past time, have had an important share in determining the distribution of vegetable structures. Here, then, we have another of the many interesting relations subsisting between the organic and the inorganic kingdoms of Nature.

From the vast formations of sedimentary strata which constitute so large a portion of the earth's crust, from mountains, from valleys, and from river-channels, we learn what changes the process of atmospheric denudation has effected, during past ages, on the configuration of the earth's surface. If we recollect, then, that each particle of every sedimentary rock must have been exposed, perhaps many times, to the action of water, the wonder is that these rocks should have retained any soluble substances whatever. Had these rocks, as they were formed, been just so much subsiding insoluble matter, when they came to constitute land manifestly they could not have afforded a soil suitable for plants, since the necessary substances had previously been removed from them. The ultimate tendency of denudation would therefore have been to reduce the productiveness of all land to a minimum, had it not been for this conservation of soluble salts by the earthy ingredients of the soil. Without this arrestment these valuable salts must inevitably have been washed into the sea, there to accumulate uselessly, whilst land vegetation, and consequently land animals, gradually disappeared. Perhaps our being able to detect many rare elements in sea water may be owing to the fact that their compounds were nearly all dissolved previous to the separation of the liquid from the solid constituents of our globe.

It may be well to recapitulate, in a few words, the cycle of operations we have endeavoured to trace:—We saw that the ammonia and nitric acid of the atmosphere (formed there by the direct union of their constituents, or derived from decaying organic matter) are washed by the rain into the soil. The soil is thereby enriched, whilst the water passes on purified. By-and-bye, however, the waters of the river become charged with sewage and other impurities, when the earthy sediment acts in the same way as the soil did on the rain water, withdrawing phosphoric acid, potash, ammonia, and nitric acid, before suffering the water thus impoverished to mingle with the ocean.

In this beautiful provision we have one of those marvellous adaptations which abound throughout the created universe, the disclosure of which everywhere repays the labours of the student of Nature.

I cannot better conclude these remarks for the present than by quoting the lines of the poet Marlowe, which seem peculiarly appropriate to this part of my subject:—

> "I walkt along a streame for pureneſse rare,
> Brighter than sunshine, for it did acquaint
> The dullest sight with all the glorious pray
> That in the pebble-paved chanell lay.
> No molten crystall, but a richer mine
> Of Nature's rarest alchemie ran there."

ANALYSIS OF COBALT AND NICKEL ORES, OF NICKEL GLANCE,

AND A CONVENIENT AND EXACT METHOD FOR THE SEPARATION OF ZINC FROM THE ABOVE-NAMED METALS.*

By Professor REMIGIUS FRESENIUS.

Owing to the great differences occurring in the analyses of similar samples of the above-mentioned ores, Prof. Fresenius introduced a new method for their treatment, which has given very satisfactory results. I will endeavour to explain his process as concisely as possible.

Method I.—Applicable to nickel glance in particular.

An accurately weighed sample is fused with eight times its amount of a mixture of equal parts of sulphur and carbonate of soda, the fused mass is treated with hot water, and the finely crystalline residue of sulphur metals is filtered off and well washed, by which operation arsenic and antimony pass into solution.

After igniting the filter the residue is treated with fuming nitric acid, and evaporated to dryness. The small amount of sulphate of lead remaining undissolved is not filtered off, but sulphuretted hydrogen gas is passed through the acid liquid till the latter is completely saturated with it. The filtrate from the sulphides of copper and lead is evaporated to dryness, the FeO is oxidised with chlorate of potash, a little HCl added, and the solution is then largely diluted, and carbonate of soda added till the reaction is nearly neutral, then acetic acid is poured in, drop by drop, till a clear brown solution of acetate of iron and nickel is formed. This done the solution is heated to boiling, and when in that state the basic salt of iron must at once be filtered off and washed. After this precipitate is re-dissolved, and again precipitated, in the basic state as before. Test a little of the precipitate
Crookes's ex free from nickel, if not, the above operation must
much heat cou all the nickel is removed. The filtrates
in such a per cipitate must be brought together and
indeed the ra a moderately small bulk. The solution is
power of the g, and caustic potash is then added in slight
however, to hydrated oxide of nickel is washed and
question. ignited, and then reduced in a stream of hydrogen gas. The resulting metal is now brought on a small filter and treated with boiling water to remove any traces of caustic potash; after ignition of the filter it is again heated in a stream of hydrogen and weighed. The small amount of silica it contains is separated by dissolving the metal, and evaporating the SiO_2 to dryness, and estimating the amount, which is to be subtracted from the total quantity.

Method II.—Especially applicable to cobalt-nickel ores, and for the separation of zinc from those metals.

Instead of the fusion process, as described in Method I., the finely powdered ore is digested for some time with aqua regia and filtered. The residue must be perfectly white, and if not so, must be fused with bisulphate of potassium, the fused mass is dissolved in HCl and water, the solution filtered off, and the filtrate added to the principal one. The analysis is then continued exactly as in Method I.

Should the ore contain zinc the sample is treated as follows:—

The sulphides of nickel and cobalt are dissolved up, the solution evaporated to a small bulk, and then chloride of ammonium added in the proportion of 5 grms. NH_4Cl to 0·2 grm. ZnO; the mass is then evaporated to dryness on the water-bath till all the NH_4Cl is removed, and with it all the zinc. The remaining residue is treated with HCl, a little NO_3 being also added; the solution is then evaporated to a very small bulk to remove the excess of acid, and then precipitated with caustic potash, and the analysis continued as in Method I.

When nickel and cobalt are to be examined *separately*, evaporate the ammoniacal filtrate to dryness, remove the ammonia salts by gentle heating, dissolve the residue in HCl, with addition of a little NO_3; and when much nickel and little cobalt is present estimate the latter as nitrite of sesquioxide of cobalt and potassa; but if, on the contrary, there is much cobalt and little nickel, the solution of the chlorides of these metals are treated with KCy in excess, and after addition of pure caustic potash the nickel is precipitated warm as black hydrated oxide of nickel.

In the first case the nitrite of the sesquioxide of cobalt and potassa, in the latter the oxide of nickel, is dissolved in HCl and precipitated with caustic potash, and eventually estimated as metal.

Glasgow, June 27, 1874.

COMPARATIVE METHOD OF DETERMINING TANNING MATERIALS.

By E. SCHMIDT.

The question to be solved is—Knowing that a certai weight, P, of pure tannin is required to obtain a certai result, how much of another tanning body, *e.g.*, the extract of a wood, is required to produce the same result None of the published methods for the determination of tannin is sufficiently precise, easy, and rapid for industrial purposes. The author proposes a modification of Pribram' method with sugar of lead.

A. *Preparation of the Test-Liquor.*—50 grms. neutral acetate of lead are dissolved in 400 grms. of alcohol at 92 per cent, and distilled water is added so as to make up 1 litre.

On the other hand, 1 grm. of tannin is dissolved i 40 grms. of alcohol at the same strength, and the solution is made up with water to the bulk of 100 c.c.

This being done, 10 c.c. of the tannin solution ar taken, 20 c.c. of water are added, and heated to 60°. Th lead liquor is then run into the hot solution with a burette graduated to tenths of a c.c., so long as a precipitate is formed. At this temperature, and with these alcoholised liquids, the precipitate forms and settles rapidly. Iodide of potassium may be used as an indicator to show excess of lead, proceeding in the same manner as is done with ferrocyanide in titrating phosphates with nitrate of uranium. If we suppose that to precipitate 10 c.c. of the tannin solution 28 degrees of the lead liquor have been required, then 2·8 c.c. of the latter =0·10 grm. of tannin.

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* Communicated by Mr. Harry G. Shaw

B. *Preparation of the Sample to be Tested.*—Suppose that chesnut-bark is to be examined. It is coarsely powdered, and 10 grms. are mixed with an equal volume of washed sand, and exhausted with water at 50° or 60° C. The filtered liquid is evaporated to dryness in the water-bath in a tared porcelain capsule. After evaporation the capsule is weighed, which shows the yield of the bark in aqueous extract. This extract is taken up in 40 grms. of alcohol at 92°, and water is added to make up 100 c.c. This liquid is filtered if needful. In this manner the resinous, albumenoid, pectic, and gummy matters are got rid off.

C. *Titration.*—The liquid thus prepared is divided into two parts. The first, one-third of the entire volume, serves for direct determination of the acetate of lead. Suppose that a gramme of the dry extract of chestnut has required—for 10 c.c. of the tannin liquor—in three successive experiments, 16, 17, and 16 degrees of the burette, which corresponds to 57 per cent of tannin. But this figure 57 represents, not only tannin, but every other substance capable of precipitating acetate of lead.

The tannin is then absorbed with bone-black, previously washed with hydrochloric acid, and dried at 100° C. in the following manner:—We act with bone-black upon the tanning liquor, and on a solution of pure tannin prepared at a standard somewhat lower than that indicated for the extract by the first direct titration. In the present case this solution of tannin should be prepared at 55 per cent.

From one and the same glass tube, about 1 centimetre in diameter, we cut off two lengths of 20 centimetres each, and we draw out each at one of its ends. The two tubes are fixed perpendicularly, with the point downwards, and plugged with a little carded cotton. Into each is put 10 grms. of the bone-black, pouring into one of them the second part of the tanning liquor under examination, and into the other the same volume of the pure solution of pure tannin at 55 per cent.

We then take of the tanning liquor (which has retained its original brown colour in spite of the bone-black) 20 c.c., and after having heated it to 60° C., we drop in the standard lead liquor from the burette as before. Two successive trials show 16 degrees, =8 degrees for 10 c.c., in place of the 16 degrees found for 10 c.c. on direct titration. On the other hand, 20 c.c. of the solution of pure tannin require 14 degrees, or 7 for 10 c.c. Thus we see that in the tanning liquor (chestnut extract) there is a certain quantity of matter which acts upon the standard lead solution like tannin, corresponding to 1 degree of the lead liquor, *i.e.*, to 357-thousandths of a centigramme of tannin, 28 degrees therefore correspond to 10 centigrammes. The figure 57 obtained by direct titration is, therefore, too high by 3·57 per cent, and the extract contains $57-3·57=53·43$ per cent of tannin.—*Bull. de la Soc. Chim. de Paris.*

CENTENNIAL OF CHEMISTRY, 1774-1874.

The following communication is being circulated by Dr. H. Carrington Bolton, through the *American Chemist* and other papers:—

The year 1774 was rendered memorable by great chemical activity. It is not possible to assign to chemistry any definite birth-year, but so many remarkable discoveries were made in 1774 that we may, with good reason, date the foundation of modern chemical science from that period.

It would be quite foreign to the object we have in view to give here any detailed account of the state of the science at the period referred to. We may mention, however, a few of the most important discoveries which made the year 1774 noted in the annals of chemistry.

The eminent Swedish chemist, Scheele, first isolated chlorine, calling it, in accordance with the accepted theories of the day, "dephlogisticated muriatic acid." He also recognised baryta as a peculiar earth, and it henceforth took a place among the elementary substances. Scheele also published in this same year his masterly essay on manganese.

Lavoisier was engaged in an investigation of the cause of the increase in weight of tin when calcined in close vessels—a research which led him to subsequent discoveries of immense importance.

Wiegleb proved alkalies to be true natural constituents of plants. Cadet described an improved method of preparing sulphuric ether. Bergman showed the presence of carbonic acid in lead white. On the 27th of September in this year Comus reduced the "calces" of the six metals by means of the electric spark before an astonished and delighted audience of *savants*. On the 1st of August, 1774, Priestly discovered oxygen, the immediate results of which were the overthrow of the time-honoured phlogistic theory and the foundation of chemistry on its present basis.

It surely requires no lengthy argument to prove that the year 1774 may well be considered as the starting-point of modern chemistry.

Now I propose that some public recognition of this fact should be made this coming summer. Would it not be an agreeable event if American chemists should meet on the 1st of August, 1874, at some pleasant watering-place, to discuss chemical questions, especially the wonderfully rapid progress of chemical science in the past hundred years.

Centennial celebrations are now in order. The Bostonians have renewed the memories of the Boston Tea-Party. Already the country resounds with preparations for a National Centennial in 1876. Why should not chemists meet to enjoy a social reunion in commemoration o events important alike to science and civilisation? Should this proposed meeting receive your approbation, have the kindness to offer suggestions as to the proper method of bringing it before the scientific portion of the communiy . Details as to place, &c., will naturally be deferred for t present.

NOTICES OF BOOKS.

Qualitative Chemical Analysis and Laboratory Practic By T. E. Thorpe and M. M. Pattison Muir. London Longmans, Green, and Co.

This work forms one of the "Text-books of Science" at present in course of publication by Messrs. Longmans, and is stated to be edited by C. W. Merrifield, F.R.S. What share this gentleman—who, if a chemist at all, is not known as such—has taken in the work, does not appear. This book is divided into two distinct parts. We have first a course of experimental chemistry extending to the non-metallic elements and their compounds.

The second part is a systematic treatise on qualitative analysis. The first section is devoted to the description of certain preliminary operations, such as the use of flame-reactions, and the employment of the spectroscope. In the second section, the reactions, both wet and dry, of the ordinary bases and acids are described, and a synopsis of analytical methods is superadded. In the third section are given tests for the rarer elements,—which we are glad to find are not omitted—and indications are furnished as to their probable occurrence. The fourth and fifth sections treat of the detection of poisons, and the examination of urine and urinary calculi. The appendix contains a list of apparatus, and chemicals required for performing the operations described in the body of the work, hints for the preparation of pure reagents, and some useful tables. Upon the whole the instructions given may be fairly pronounced accurate, and judiciously selected. In speaking of the molybdic test for phosphoric acid, it might have been well to point out the means of discriminating between the phosphoric compound and the analogous deposits formed by the silicic and arsenic acids. The book will prove serviceable as a guide to students desirous of acquiring a knowledge of analytical chemistry.

A Treatise on Food and Dietetics Physiologically and Therapeutically Considered. By F. W. Pavy, M.D., F.R.S. London: J. and A. Churchill.

No modern systematic treatise on this subject has hitherto existed in the English language, and Dr. Pavy has therefore undertaken a most important and useful task. The work begins with general introductory remarks on the dynamic relations of food, and on its origination. Alimentary principles are arranged under the four groups of nitrogenous principles, hydrocarbons or fats, carbohydrates and inorganic materials; the colloquial distinction of "food and drink," and Liebig's classification into plastic and respiratory elements being shown to be unsatisfactory. The preponderant importance of nitrogenous matter for the development and renovation of the tissues is fully recognised. But the doctrine that muscular work is dependent on, and proportioned to, the destruction of muscular tissue by oxidation is abandoned. On this point the well-known experiments of Drs. Fick and Wislicenus seem convincing. The elimination of urea appears, indeed, to stand in a much closer relation to the food taken than to the work performed. In a cat the amount of urea excreted daily per kilogramme of body weight, was seen to rise from 2·958 grms. to 7·663, with an increase of the amount of meat eaten from 44·188 to 108·755 grms. The fats especially, and the non-nitrogenous organic portion of food generally, are regarded as heat, or more correctly as force-generators, the respective amounts of heat produced by 1 gramme of grape-sugar, starch, and fat being 3277, 3912, and 9069. But the nitrogenous constituents of food in addition to their tissue-forming function, share also in the evolution of heat, 1 grm. of albumen yielding 4263 units of heat. The dispute as to the dietetic value of alcohol is fully stated. Liebig considered that it was consumed by oxidation like other non-nitrogenous alimentary principles, and that it stood second to the fats only as a respiratory material. This view met with very general acceptance until the experiments of MM. Lallemand, Perin, and Duroy were made known. These physiologists found that alcohol passes off from the body in an unchanged state after its ingestion. The breath, perspiration, and urine, both of men and of lower animals dosed with alcohol, was tested, and its presence was very plainly shown. In the brain of an animal killed 36 hours after the consumption of alcohol, it was also recognised. The test used was extremely delicate; one part of bichromate of potash was dissolved in three hundred parts of pure concentrated sulphuric acid, forming a bright red liquid, which, in contact with alcohol, by a well-known reaction changes to an emerald green. But the test is unfortunately too delicate. Dr. Dupre found that six weeks after total abstinence from alcohol, and even in the case of a teetotaller, a substance was eliminated in the urine which gave all the reactions ordinarily used for the detection of traces of alcohol. On the other hand, none of the experiments on the faith of which the transformation of alcohol within the system was denied, have been at all quantitative. That a liquid so volatile as alcohol should be recognised in the excretions, is certainly no proof that it entirely escapes transformation.

The author next passes to the more popular branch of his subject. Taking in review the various articles of food, he gives an account of their chemical composition and their dietetic value. The occasional unwholesomeness of meat in consequence of trichinæ, of malignant disease, or of decomposition is fully described. It is to be regretted that in speaking of blood its very objectionable character as an article of food has not been mentioned.

In the important section on Practical Dietetics, the vegetarian question is very fairly examined. It strikes us that the dietetic reformers find themselves in a dilemma. If they allow the use of milk and eggs, as most of them do, they greatly improve their cookery at the expense of their logical consistency. If they reject milk they accuse nature, or rather God, of an error in having appointed it for the nurture of the young of the highest animal group. It must also be remembered that certain rodents, such as the common rat, depart more widely than we do from the carnivorous type in their dentition, and yet are omnivorous. At the same time, we must admit, with Dr. Pavy, that "the consumption of meat to the extent that many persons believe necessary for the maintenance of health and strength is not really so."

This work is not only indispensable to the medical practitioner, but it is one with which every educated man ought to make himself familiar.

Annual Record of Science and Industry for 1873. Edited by Spencer F. Baird. New York: Harper Brothers.

A valuable collection of facts, taken from the leading scientific and technological journals of America, England, and the Continent. Though the abstracts given are necessarily brief, the work forms a kind of general index or key to the researches, discoveries, and improvements made during the year, and refers those who require more detailed information to the original documents. The space devoted to "Chemistry and Metallurgy" does not exceed eleven pages, but the section "Technology" is mainly devoted to the chemical arts. It is curious to find a bad process for making gun-cotton, derived originally from an American source, quoted from a French journal, and placed under the head "Mechanics and Engineering." As a manual for reference we consider this work a decided improvement on the Year-Book of Facts.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—I am quite of the opinion of your correspondent "Equivalent" with regard to the *Journal of the Chemical Society*. In its present condition it is an expensive and blundering attempt to monopolise the literature of chemistry in this country. The appointment of "abstractors" was an error. Surely Mr. Watts, who has shown himself so enthusiastic a compiler, could have done the compilations and abstractions necessary for the Journal at less than half the cost. But I do not agree with your correspondent when he suggests a return to the old *quarterly* issue; this, I take it, is simply satirical. Let the Journal be issued monthly as before, and devoted simply to the papers read at the Society, and the discussions thereon. Fancy the *Comptes Rendus* of the Paris Academy giving "abstracts of foreign papers!" Let the *Journal of the Chemical Society* be the organ of the Society, and not endeavour to compete with journals of chemistry properly so-called.

The above remarks do not apply to the excellent journal of the *Societe Chimique* of Paris, for that was a journal before the Society was formed.—I am, &c.,

F. C. S.

ABSORPTION OF NITROGEN BY SOIL.

To the Editor of the Chemical News.

Sir,—The results obtained by M. P. P. Deherain, of which you have recently given us a *resume*, are clearly of great importance, but until the reaction he has studied is further elucidated it will be difficult to draw any practical conclusions from his experiments. Thus he assumes that more or less of the nitrogen that disappears from the experimental atmosphere is converted into ammonia, but I have been unable to find in his original papers that he actually ascertained the presence of ammonia in any instance; while the nitrogen found in some of his experiments after evaporating to dryness a caustic soda solution could not possibly have existed as ammonia.

Again, he finds that most nitrogen is absorbed from the atmosphere when no oxygen is present, and concludes that the vegetable matter in the deeper layers of the soil will in the same way absorb nitrogen, and thus enrich the soil. T. Schlœsing has, however, shown that a vegetable soil containing nitrates undergoes a striking change if deprived of oxygen, free nitrogen being *evolved* in greater quantity than that of the nitrates present, so that nitrogenous organic matter is plainly decomposed.

It seems therefore premature to conclude, in the absence of further evidence, that soils are actually enriched with nitrogen in the way that Deherain supposes. He considers, however, that soil must obtain nitrogen from the atmosphere, because the nitrogen in crops is generally greater than the nitrogen in the manure. He should show, however, that the nitrogen in crops is greater than the nitrogen in manure, *plus* that received in rain, and that absorbed as ammonia (by crops and soil) from the atmosphere, before the argument can be of any weight; and agricultural chemistry is hardly yet in a position to supply the requisite data.—I am, &c.,

R. Warington.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 18, 1874.

Note accompanying the Presentation of Vol. VI of the "Œuvres de Lagrange."—M. Serret.—This completes the series.

On Magnetic Bundles made up of Separated Plates.—M. Jamin.—Combining 22 magnetised plates (each 1 m.m. long, 1 m.m. thick, and 50 m.m. broad) in a bundle, with pasteboard 0·6 m.m. thick between adjacent plates, each plate lost magnetism, and so the bundle, the loss of the latter being 50 per cent, which is less than in the case (first experimented on) of superposition without intervals; the loss was then 66 per cent. In this first mode all the magnetism retained was carried to the exterior; there was none, or almost none, between the plates. In the other mode the quantity remaining (151·1) was divided into two portions:—(1), 85·5, which was expanded on the exterior; and (2), 65·6, which remained in the intervals. With wider intervals the exterior magnetism is diminished, the interior increased; and gradually the plates act as if they were independent.

Letter of M. Faye, enclosing Reply by M. Gautier.—M. Gautier argues for the idea of solar "scoriæ," commending the study of molten alloy (brass *e.g.*), the phenomena of which are strikingly analogous to what appears in the solar furnace. He confirms Mr. Langley's observation ("Monthly Notices") of an appearance of crystallisation in some spots, suggesting rather mineral or saline deposits, or certain gemmation, than the action of cyclones. M. Faye thinks the identity of spots with cyclonic phenomena would long since have been recognised had not singular notions been prevalent about the latter. Against these M. Faye directs all his efforts (he says). The persistence of the solar spots is no difficulty, as even our cyclones may last for whole weeks.

New Apparatus for the Transfusion of Blood, proposed by M. Mathieu.—M. Bouley.—This apparatus (of which a drawing is given) consists of a glass receiver, communicating above with a funnel, below with the vein. The tube between funnel and receiver passes through an ampulla of caoutchouc, which forms a reservoir of air, communicating with the air in the receiver. Blood poured into the funnel passes to the receiver, and the ampulla, being then pressed, is forced into the vein. On relaxing the pressure, air returns to the reservoir from the receiver, into which more blood then flows from the funnel.

General Ideas on the Mechanical Interpretation of the Physical and Chemical Properties of Bodies (*continued*).—M. Ledieu.—This important paper is hardly suitable for abstraction. The author regards the ether as of the same nature as *ponderable* substances; its differences from these, more apparent than real, depend both on the functions of the distances measuring the molecular action of its atoms on one another and on the heavy atoms, and on the relative smallness of its atomic mass. To the former is due the extreme *elasticity* attributed to the ether; to the latter the *imponderability*, which is essentially relative, "and will, in all probability, be one day proved experimentally, by some physicist of genius."

Note on some Thermometric Observations during Winter, in the Alps.—Dr. Frankland.

Influence of Ferments in Surgical Maladies.—M. Alph. Guerin.—The author maintains that fermentation is not produced in pus which is in contact only with filtered air. His observations were upon wounds kept covered with wadding. Good ventilation in hospitals may not alone do much to remedy the conditions of putrid fermentation.

Employment of Fragments of Iron instead of Lead Shot in the Rinsing of Bottles.—M. Fordos.—Lead shot, where so used, often leaves carbonate of lead on the internal surface, and this is apt to be dissolved in the wine or other liquids afterwards introduced, with poisonous results; and particles of the shot are sometimes inadvertently left in the bottle. M. Fordos states that clippings of iron wire are a better means of rinsing. They are easily had, and the cleaning is rapid and complete. The iron is attacked by the oxygen of the air, but the ferruginous compound does not attach to the sides of the bottle, and is easily removed in washing. Besides, a little oxidised iron is not injurious to health. M. Fordos further found that the slight traces of iron left had no apparent effect on the colour of red wines; it had on white wines, but very little; and he thinks it might be better to use clippings of tin for the latter.

Transmission of Irritation from one point to another in the Leaves of Drosera, and on the Rôle played by the Tracheæ in these Plants.—M. Ziegler.—It is by the tracheæ or surrounding fibres that the irritation is transmitted from hair to hair, and they must be able to communicate with each other laterally by their points of contact.

Shock of Bodies.—M. Darboux.

Temperature of the Sun.—M. Violle.—The author here deals with the *static* method, in which a thermometer is exposed to solar radiation till the temperature indicated by it is stationary, and this temperature is then compared with that of the enclosure. Suppose a smoke-blackened sphere with blackened thermometer bulb, but infinitely small, at the centre. In equilibrium of temperature the enclosure sends to the thermometer a quantity of heat, Sa^t, a being the constant of Dulong, or 1·0077, and the thermometer sends back the same quantity. Now pierce a circular hole, ω, in the sphere, such that it is seen from the centre under the same angle as the apparent diameter of the sun, and direct it to the sun. The real action of the sun on the bulb will then be the same as that of a small disc of surface, ω, placed at the hole, and having the same diameter and emissive power as the sun. We may, then, define the temperature of the sun by the temperature we must attribute to this imaginary disc, having the emissive power of soot, to produce on the thermometer the same effect as the sun actually produces. Let x be this temperature, θ the stationary temperature of the thermometer receiving solar radiation through ω: the quantity of heat emitted by the thermometer, which was Sa^t at temperature t, is become Sa^θ; and putting this quantity equal to the sum of the quantities emitted by the enclosure and by the sun, we have $Sa^\theta = Sa^t + \omega a^x$. This is exactly M. Vicaire's formula; but a term of correction has to be introduced, for the thermometer has finite dimensions, and the hole has to be enlarged so that the solar rays may meet the whole of one hemisphere of the bulb. Consider, then, an aperture, Ω, large enough for this. Each point of the bulb, if the latter be small enough relatively to the enclosure, will be nearly in the same condition. Take any point then: it is subject (1) to the radiation of all the protected portion of the enclosure; (2) to the radiation of the sun equivalent to that of a surface ω placed at a distance equal to the radius of the sphere, and maintained at the same temperature as the sun; (3) to the radiation of a portion of the sky near the sun, which acts as a surface, $\Omega - \omega$, of an unknown temperature, y. The exact equation is, then, $Sa^\theta = Sa^t + \omega a^x + \Omega a^y$. The author gives an example of his actual observations, in which the total intensities of the three radiations to the thermometer, by the surfaces S, ω, and Ω, were nearly proportional to the numbers 15, 1, and 0·1.

Studies on Electric Chronographs and Researches on the Induction Spark and Electro-Magnets.—M. Deprez.—The author sought (by a method described) to determine the retardation of the induction spark, *i.e.*, the time elapsing between rupture of the inducing current and explosion of the spark. Of all methods of registering this is the most rapid, the retardation being generally less than $\frac{1}{10000}$ of a second. But the spark presents disadvantages; its production is very capricious, and depends much on the manner of rupture; it is nearly always multiple, and it thus struck several points of the cylinder (in the arrangement adopted). When the cylinder moves very quickly its trace became very uncertain. A large induction coil is required. And the number of sparks one coil can produce in a second does not exceed two or three hundred. This was insufficient for the author's purpose (which was to find twenty points of a curve representing the pressure of gases of powder in a gun). For he had to produce two consecutive signals at an interval of $\frac{1}{10000}$ of a second. He had therefore to use twenty independent bobbins and twenty batteries. He tried the other processes of electric registration, the use of electro-chemical paper, and that of electro-magnets. The first was abandoned as inferior to the induction spark, the second he succeeded in improving till he could measure the duration of a phenomenon with an error less than $\frac{1}{20000}$ of a second, and that with a very simple and cheap apparatus. Details will be given later.

Movements of Air in Tubes.—M. Bontemps.—In the pneumatic tubes for transmission of telegrams, there being an engine at the end supplying air to drive the case along, the manometer at this end, after a short interval from the time of dispatch, becomes stationary. There is a permanent state succeeding a variable. 1. When the permanent state is established the velocity of the case is uniform. 2. The separation (*ecart*) of the two pistons, which have a common motion in the tubes, is maintained throughout the whole portion of the distance from which the *regime* is produced. The author then asks: Is not the movement of the air that of a fluid of constant density, in which, consequently the pressure and the temperature vary proportionally? If so we may attempt an application to this new class of phenomena of the law of Ohm governing the the galvanic current. He does so.

Studies of the Properties of Explosive Substances.—M. Abel.—(Fourth Memoir). Refers to the velocity with which duration is transmitted in various circumstances.

Compounds of Arsenic Acid with Molybdic Acid.—H. Debray.—These two acids form compounds as complex and as well-defined as the phospho-molybdates. H. Rose pointed out that arsenic acid forms with molybdate of ammonia in a nitric solution a yellow precipitate like that given by phosphoric acid under the same circumstances. This substance, like its analogue, is the ammoniacal salt of a compound yellow acid, resulting from the combination of 1 equivalent of arsenic acid with 20 equivalents of molybdic acid. Its composition may be represented by $3NH_4O,AsO_5,20MoO_3$.

Soluble Starch.—M. Musculus.—Chemists are not agreed as to what should be understood by soluble starch. Some apply this name to a matter which takes a blue colour with iodine, which may be washed out of starch by means of water, and which Vaegeli has called granulose. In the opinion of others the true soluble starch is the substance which Béchamp obtained on acting upon starch with sulphuric acid, and which takes a violet colour with iodine. Granulose, though it readily passes through filter-paper, is not truly soluble in water. By evaporation it may be separated in a state completely insoluble even in boiling water. Béchamp's soluble starch is a mixture of several bodies, including granulose, true soluble starch, and products of the decomposition of starch, such as dextrin, glucose, or glucosin. The author has described under the name of globulised dextrin a body, insoluble in cold water, obtained by dissolving starch in acidulated boiling water, and evaporating to a syrup after neutralising the acid and filtering. There is formed an abundant deposit of granules, insoluble in cold water, but soluble at 50°, so that they may be freed by washing from accompanying traces of dextrin and glucose. By means of alcohol they may be purified from granulose, and we thus obtain pure soluble starch. When dried in the air it is white and resembles starch. If recently washed it is insoluble in cold water, and does not reduce salts of copper. If left for some time in contact with water it dissolves sensibly, a little sugar being formed at the same time. Its rotatory power is almost quadruple that of dehydrated glucose. It dissolves perfectly in water at 50°, and is not re-precipitated as the solution cools. Diastase splits up soluble starch in the same manner as common starch, but much more readily and perfectly.

Decomposition of the Tungstate and the Molybdate of Soda by Sal-ammoniac.—F. Jean.—The tungstate and the molybdate of soda are decomposed in an identical manner when kept in ebullition with sal-ammoniac. The chlorine of this salt saturates the base of the metallic salt, the acid of which combines immediately with the liberated ammonia to form an alkaline salt, which, on boiling, becomes an acid salt and loses ammonia. It is remarkable to find a decidedly acid liquor which evolves ammonia.

Constitution of Clays.—Th. Schlœsing.—This valuable paper is reserved for insertion in full.

Identity of Bromoxaform and Pentabromated Acetone.—E. Grimaux.—The author finds that acetate of methyl and methyl-alcohol are not attacked by bromine in the cold; that at 150° to 170° the acetate of methyl is transformed into bromide of methyl and bromacetic acids; that the compound formed by the action of bromine upon the alkaline citrates is pentabromated aceton; that the chlorated bodies obtained by Plantamour in the action of chlorine upon citric acid and the citrates are chlorated derivatives of aceton and not derivatives of methyl-acetic ether.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 6, March 20, 1874.

At the meeting of the Society, February 20, M. Willm communicated a memoir by M. Cleve on didymium, and a note by M. Nilson on the selenites. M. Grimaux presented a paper by M. Franchimont on the preparation of malonic acid. M. Friedel announced that when studying conjointly with M. Jules Guerin, the compounds obtained by the action of hydrogen on chloride of titanium, he found that the gold-coloured lamellæ which Ebelmen took for a protochloride, are in reality an oxychloride. This latter is obtained in much greater abundance by passing a mixture of chloride of titanium, and of hydrogen over titanic acid. He pointed out a curious reaction of sulphate of alumina, which at common temperatures, and more rapidly with the aid of heat, transforms fluoride of calcium into sulphate of lime, fluoride of aluminium being produced at the same time. M. Pisani finds that turnerite, a rare mineral regarded as a phosphate of lime, is identical with monazite, the phosphate of cerium. M. Millot made known the first results of his investigations on the phosphates of iron and alumina. M. Henninger communicated the continuation of his researches on the reduction of the polyatomic alcohols by formic acid.

New Saccharimeter, to be used by Perfectly Monochromatic Light.—M. Leon Laurent.—This improved saccharimeter has been already noticed in the Chemical News. The details of its construction would be unintelligible without the aid of illustrations.

Researches on Didymium.—M. P. T. Cleve.—The author describes the sesquioxide, chloride, bromide, chloroplatinate, chloraurate, bromaurate, fluorine, platino-cyanide, ferrocyanide of didymium and potassium, sulphocyanide, nitrate, perchlorate, iodate, periodate, formiate, acetate, seleniates, potassio-sulphate, potassio-seleniate, ammonio-sulphate, ammonio-seleniate, sodio-sulphate, sodio-seleniate, sulphite, selenite, hyposulphate, carbonate, potassio-carbonate, ammonio-carbonate, sodio-carbonate, oxalate, potassio-oxalate, tartrate, and pyrophosphate.

Salts of Selenious Acid.—M. L. F. Nilson.—The author gives an analysis, and a brief description, of a number of selenites.

Preparation of Malonic Acid.—M. Franchimont.—The author modifies the procedure of Kolbe and Muller, substituting brom-acetic ether for chlor-acetic. Succinic acid is found among the products.

Comparative Method of Determining Tanning Materials.—E. Schmidt.

New Apparatus for Determining the Tannin Contained in the Different Astringent Matters Employed in Tanning.—A. Terreil.—This paper requires an illustration. The principle of the process is the absorption of oxygen by tannin in presence of alkaline liquids. The author admits that the determination requires twenty-four hours for its completion.

April 5, 1874.

At the meeting of the Society, March 6, M. Terreil gave an account of the properties and mode of preparation of certain alloys of manganese, founded upon the action of the metals upon anhydrous manganic chloride. This chloride is obtained in a fused state by heating the dried chloride in a current of hydrochloric acid gas. Aluminium decomposes the chloride, yielding an alloy, Mn_3Al, which scratches glass. Its fracture resembles that of amalgamated tin. The alloy of manganese and magnesium is softer. Zinc acts upon chloride of manganese with explosion.

M. Basarow communicated the first results of his researches on fluoxyboric acid. This supposed acid appears to be merely a solution of the fluoride of boron in water.

M. Jannetaz described a variety of hydrated silica, found at Bry-sur-Marne. It loses its water spontaneously, but does not cease to be soluble in alkalies. It resumes its moisture—33 per cent—if allowed to remain in water. It presents the general characters of the zeolites.

Action of Hypobromites upon the Nitrogenised Matters of Urine, with an Application to the Determination of Urea and Uric Acid.—M. E. Magnier de la Source.—Solutions of urea are completely decomposed in the cold by hypobromite of sodium. If an excess of soda is present nitrogen alone is given off. The presence of chloride of sodium does not hinder the decomposition. Creatine is also completely decomposed under the same circumstances. Uric acid only loses half its nitrogen in the cold, but if heated the decomposition is complete. The directions for the determination of urea and uric acid should be accompanied by a diagram.

On a Natural Phosphate of Cerium containing Fluorine.—This mineral is found at Kararfvet, near Fahlun, in Sweden. Its colour is a light yellow shading into brown, its lustre feebly vitreous. It yields a greyish-yellow powder, and its specific gravity is 4·93. The crystals are very large. Hydrochloric acid attacks it slowly and imperfectly, with disengagement of chlorine. The mineral is completely attacked by fusion in fine powder with bisulphate of potash or carbonate or soda. If heated with concentrated sulphuric acid it dissolves without residue. It is infusible before the blowpipe. It has the property of double refraction. It is found scattered in felspar albite, and is almost always associated with gadolinite (silicate of yttria and cerium), hjelmite (a variety of yttrotantalite), emerald, &c. Its average composition is—

Oxide of cerium „ lanthanum „ didymium	67·40
Lime	1·24
Magnesia	traces
Oxide of iron	0·32
Phosphoric acid	27·38
Fluorine	4·35
Water	traces
	100·69

Action of Ammonia upon Aceton.—W. Œchsner De C. and A. Pabst.—In the action of ammonia upon aceton there are formed no traces of methylamine and aldehyd. The product of the reaction is the acetonin of Stædeler.

Correspondence from St. Petersburg.—Feb. 18 (March 2), 1874; M. W. Louguinine.—This paper contains an account of the recent progress of chemistry in Russia, and of the researches of M. Mendeleeff—physical rather than chemical—of the resistance of glass tubes to internal pressure, and on the exact measurement of temperatures. M. Boutteroff communicates a description of an apparatus for the production of hydrochloric acid; researches on the terebene and cymene obtained from the essence of terebenthine; on behalf of Wagner and Zaytzeff, a preliminary note on a new synthesis of the alcohols; on behalf of Wreden, on the hexa-hydro isoxylene which he has obtained from isoxylene as well as from camphoric acid. The latter the author considers a mixture of two isomers. Markovnikoff communicates results of experiments made by Demstchenko, on the action of the protochloride of phosphorus upon isobutyric aldehyd, which transforms the latter into a crystallisable polymer, which melts at 59° to 60° and distils at 194°; also a third isomer of pyrotartaric acid, obtained by Kolbe's method. On behalf of Elisafoff, a paper on the cetene of cetylic alcohol, which the author considers as a mixture. Papers have also appeared by Lazarenko, on cetene; by Dianine, on the action of chloride of benzol on dinaphthol; by Menschoutkine, on the parabanates of silver; by M. Schœne, on the reaction of water and ozone; by M. Lioubavine, on the action of ammonia upon valeric aldehyd. Kourbatoff has examined the oil extracted from the root of *Acorus Calamus*. Drobiasguine has experimented on the transformations of ethyl-crotonic acid. M. Effit Eghis has published a paper on the theory of etherification.

Relation between the Specific Gravity of Bessemer Steels and their Percentage of Carbon.—Koppmayer.—The author finds that each increase of carbon corresponds to a decrease of specific gravity.

Researches on Alloys.—M. A. Riche.—A series of results relating rather to the mechanical than the chemical properties of certain alloys.

April 20, 1874.

Chemical Purification of Wool.—MM. Duclaux, Lechartier, and Raulin.—This paper treats of the removal from wool of the so-called "burls," *i.e.*, fragments of straw, thistles, and other vegetable matter, which, getting entangled in the fleece of sheep, accompany the wool through all stages of its manufacture. As the burls do not take the same dyes as the wool, the goods must either be submitted to a separate process of burl-dyeing, or the spots must be touched with special solutions made for the purpose, "burling-inks," or, lastly, the burls must be plucked out by hand with pincers. Processes have therefore been patented, by Fenton and Crom in England (1853), and by Izart and Lecoup in France (1854), for destroying these "burls" with acids. The process consists in steeping the wool, either raw or woven, in sulphuric acid, at 3° or 4° Baumé, draining it in a centrifugal machine, and drying it in a stove at 100°. The authors have examined all the circumstances of this process: they find that the addition of alum and salts of tin to the destroying acid has no good effect, and greatly interferes with the subsequent dyeing operations; that the draining in the centrifugal machine cannot safely be dispensed with; and that the following limits of heat, proportion of acid, and time of action cannot safely be exceeded:—If the stove is at 80° C., and the goods are to be heated two hours, the acid may run from 1½ to 4½ litres for 100 of water; if it is to be heated only half an hour, the acid may range from 3 to 7 litres. If the stove is at 110°, the acid is 1 to 3 litres per cent for two hours, and 1½ to 4½ for half an hour. If the heat is 150°, the acid should be ½ to 1 litre per cent for two hours, and 1 to 1½ litres for half an hour. Very prolonged washing with hot water, alkaline solutions, and cold water, is required to remove all superfluous acid after the burls are destroyed. Without great care the nature of the wool is affected, and its affinity for dyes enfeebled.

Researches on Erbium and Yttrium.—P. T. Clève.—The author has examined the ammonio-carbonate of yttrium, the potassio-sulphates of yttrium, the acetates of yttrium and erbium, the chloroplatinate of yttrium and of erbium, the chloraurates of both bases, the chloromercurate of erbium, the compounds of the sulphocyanates of both bases with cyanide of mercury, the basic nitrate of erbium, the formiates of yttrium and of erbium, the seleniates, potassio-seleniates, and ammonio-seleniates of both bases, the ammonio-sulphate and sodio-sulphate of erbium, and the sodio-carbonate of erbium.

Transformation of Toluene into Orcine and Orceine.—Vogt and Henninger have patented the following process:—Toluene, or monochlorated or monobromated toluene, is treated with concentrated sulphuric acid, so as to produce a sulpho-conjugated acid, or a monochloro- or bromo-sulpho-conjugated acid of toluene, mixed with excess of sulphuric acid. To this mixture lime and chalk are added, which separate the excess of sulphuric acid as sulphate of lime. Or, in order not to lose any sulphuric acid, the product may be allowed to act upon common salt. Hydrochloric acid is evolved, and the residue contains sulphate of soda and the sulpho-conjugated acids of toluene. Water is added, and the liquid containing the conjugated acids is decanted, and is finally neutralised with lime. The solution contains the disulpho-toluolate or chloro- or bromo-cresyl sulphate of lime, which are transformed into sodic salts by means of the sulphate or carbonate of soda. These salts, dried and melted, with double their weight of soda or potash, either under pressure or in the open air, yield orcine and alkaline salicylates. The reaction takes place from 280° to 300°. The melted mass is dissolved in water, neutralised with hydrochloric or sulphuric acid, concentrated, and the alkaline salts crystallised out. The mother-liquor contains orcine, which—by treatment with ammonia, lime, and air—is converted into orceine, the colouring matter of orchil.

MISCELLANEOUS.

Royal School of Mines.—On Saturday last, July 4, a meeting of the Council of the Royal School of Mines was held at the Jermyn Street Museum, at which the reports of the examinations of the students connected with that Institution were received and considered, and the prizes awarded. The following gentlemen received the Diploma of "Associate of the Royal School of Mines:" —*Mining, Metallurgical, and Geological Divisions*—S. A. Hill and W. Saise. *Mining and Metallurgical Division* —R. Cowper, A. R. Guerard, and C. Lloyd Morgan. *Metallurgical Division*—W. Pearce. *Geological Division* —A. R. Willis and W. Frecheville. The two "Royal Scholarships" of £15 each for first year's students were awarded to Henry Louis and E. Fisher Pittman. H.R.H. The Duke of Cornwall's Scholarship was awarded to A. R. Willis, and the Royal Scholarship of £25 to W. F. Lowe. The Edward Forbes Medal and Prize of Books were awarded to A. R. Willis. The De la Beche Medal and Prize of Books to C. Lloyd Morgan. The Murchison Medal and Prize of Books to A. R. Willis.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improved means of, and apparatus for, taking photographs at night. Eugen Ernst Johannes Sell, Chancery Lane, Middlesex. October 10, 1873.—No. 3288. I have found that, if bisulphide of carbon is burned with peroxide of nitrogen, the light produced will act on photographic paper in the same way as sunlight. The bisulphide of carbon is kept in a lamp suitably constructed, and the peroxide of nitrogen being carried into the flame completes the combustion.

Improved combinations of ingredients for cleansing and bleaching wools and other suitable fibres and fabrics, paintwork, floors, casks, and other articles and utensils. William Alfred White, London Street, London. (A communication from Arthur Lloyd, Paris). October 11, 1873.—No. 3310. The compositions are as follows:—1st. 22 parts of dry carbonate of potash, 50 of sand free from alumina and iron, and 2 of charcoal. 2nd. 22 parts of dry carbonate of sodium, 70 of dry carbonate of potassium, 20 of silicate, and 1 of charcoal. 3rd. 1 part of silica, and 2 parts of chloride of sodium.

A new or improved process for plating, coating, or covering iron direct with silver or gold. Stanislas Louis Desalot, Southampton Buildings, Holborn, Middlesex. October 14, 1873.—No. 3322. The feature of novelty of this invention consists in plating or coating iron with silver or gold directly, and without the aid of copper, as now practised by electro-platers. In order to accomplish the above object, it is necessary to manufacture the iron according to the following formula:—To every 1000 pounds weight of iron rendered liquid by heat, I add 12 pounds of nickel and ½ pound of manganese. The iron thus prepared may then be plated or coated with silver direct, by a silvering mixture composed as follows:—To every 100 pints or pounds weight of water, I add 2 ounces of azotate or chloride of silver (very neutral), 2 pounds of bicarbonate of soda, 6 ounces of cyanide of potassium or sodium, and 10 drops of cyanhydric acid. To coat iron prepared as above with gold direct, I employ a mixture composed as follows:—To every 100 pints or pounds of water, I add ½ ounce of chloride of gold (neutral), 4½ pounds of bicarbonate of soda, 1½ pounds of pyrophosphate of soda, 1 ounce of cyanide of sodium, and 2 drops of cyanhydric acid. To silver or gild the iron with the foregoing mixtures, the iron must first be rubbed with the hand, and then immersed in a liquid composed as follows:—To every 100 pints or pounds of water, I add 1 pound of slaked lime. The iron after immersion is immediately placed in a bath, without being first dried, and subjected to the ordinary electro-metallo-plastic process, and in this manner and by these means I am enabled to coat iron direct with silver or gold.

Improvements in the manufacture of manure. Thomas Almond Metcalfe, Falsgrave, Scarborough, York, and William Massingham, East Stockwith, near Gainsborough, Lincoln. October 15, 1873.—No. 3329. This Provisional Specification describes grinding refuse fish with gypsum and vegetable charcoal or other absorbent or deodorising material: animal refuse or sea-weed may be treated in like manner.

Improvements in the means employed for treating sewage. John Towle, J.P., Oxford. October 15, 1873.—No. 3331. This invention consists in filtering the liquid sewage through beds of town refuse contained in pits or receivers, having perforated floors placed over a pumping-well or receptacle for the filtered sewage. The sewage is pumped from the well into a tank to be distributed where desirable by suitable hose and pipes.

NOTES AND QUERIES.

Separating Palmitin and Stearin.—I shall be much obliged if you can, in the next number of your journal, inform me whether any process is known whereby palmitin and stearin may be separated from each other with accuracy on a small scale, so as to allow of a quantitative determination.—A Subscriber.

THE CHEMICAL NEWS.

Vol. XXX. No. 764.

THE PARLIAMENTARY COMMITTEE ON THE ADULTERATION OF FOOD ACT.

In our last two issues we have commented on some part of the evidence laid before this Committee. We have now to examine the Report, in which it embodies the results of its investigations. In so doing, we must admit that our prevalent feeling is disappointment. The Committee "has held fourteen meetings and examined fifty-seven witnesses," and has, with a curious infelicity, out of all this mass of evidence selected for recommendation precisely the most injudicious and impracticable suggestions.

The present Act is spoken of with exemplary impartiality. It is said to have "done much good," and at the same time to have "inflicted considerable injury." We scarcely see that the former conclusion is borne out by the evidence. On the contrary, the very facts adduced show it to have been little more than a dead letter. Out of 171 boroughs and 54 counties, only 26 boroughs and 34 counties have appointed analysts. The articles of food mentioned are few—tea, milk, butter, bread, corn-flour "mixtures," wine, beer, and spirits. Sugar is overlooked, as also coffee, except it be included by implication under the head "mixtures." As for sauces, jams, pickles, and confectionery, the articles most likely to contain pernicious admixtures, they are not even mentioned.

Regarding tea, it is suggested that it should be examined on landing by the Customs, and that if "seriously" adulterated it should not be admitted for home consumption. Adulterations, we must here remark, are generally "serious." If slight in amount, they would prove unremunerative. Whether the seizure of sophisticated teas by the customs would be a protection to the consumer is doubtful. It seems to us that the dealers interested in the sale of such teas would set up operations on this side of the water.

The passage on milk is one of the least satisfactory portions of the whole Report. The Committee endorse very exaggerated views as to the variability of this secretion, based on the results of analysts, who, if not inaccurate, had not the advantage of employing the most modern methods. It appears that, the more the procedures of milk analysis are improved, the less variation is observed in the results. The "solids not fat" appear to be, practically speaking, a constant; being very little, if at all, greater in "strippings" than in ordinary milk. If we attend to this point, we shall find that the "first and last pint of milk which a cow gives at the same milking do not present all the differences" between a natural and a watered milk. Furthermore, milk, before reaching the consumer, may be safely presumed to have become, to a great extent, averaged.

In "mixtures," the Committee do not see that a statement of the proportion of each ingredient used could be any real protection to the consumer. They think that, "by using a lower quality of cocoa-beans, a pure article may be made at a lower price than some of the mixtures." Is any merchantable quality of cocoa-beans cheaper than Iceland moss, or than potato-starch?

We were not without hope that the sale of mixtures of coffee and chicory would have been condemned, or that it would have been at least recommended that the respective proportions of the ingredients should be stated; but this matter has not, apparently, been considered worthy the notice of the Committee.

From the consideration of the various articles of food, the Report passes to a series of general recommendations concerning the amendment of the Act. The question as to whether special medical knowledge should be required of candidates has been shelved. Concerning the proposal to erect the Somerset House Excise Laboratory into an ultimate court of appeal in disputed cases, we have already expressed our opinion. The Committee speak of the "incompetence and inexperience of the analysts," and yet would set over their heads a few men who, save in excisable articles, have probably still less experience! We shall not attempt to calculate the number of "really competent analysts in this country." It is interesting that those who form a very low estimate always include themselves in the select minority. The Committee seem to have a vague notion that chemical analysis is an art, one and indivisible, which, when once learned, can be applied indiscriminately and with equal ease to all classes of bodies. As our readers well know, this is not the case. Whenever it becomes requisite to find the value of new groups of substances, new methods have to be discovered, verified, and improved. This is eminently the case with the analysis of food, which till lately was without trustworthy and accurate methods. Yet, if the recommendations of the Committee become law, the men who are successfully effecting these improvements will find themselves set aside, and their results disputed and overruled. Misfortunes, as we know, rarely come alone. Not only is Somerset House to be established as the final Court of Appeal, but it is proposed that "the Local Government Board should have the option of calling upon the analyst for a certificate of having passed an examination at the School of Chemistry at South Kensington!" Why this one school should be placed in such preeminence above all other chemical schools in the kingdom, public and private, we fail to see. Cannot a due knowledge of chemistry be acquired, *e.g.*, in the laboratories of University College, or of King's College, or of the Royal Agricultural College at Cirencester? Is not the University of Oxford providing increased facilities for chemical studies? Why, then, should the certificate of South Kensington be entitled to sole and exclusive recognition? Are those who have passed, perhaps in high honours, at these colleges, to present themselves for re-examination at South Kensington, which will always seek to give the preference to its own pupils? The effect of this proposal would be to constitute the head of the South Kensington School, for the time being, as the arbitrary and irresponsible ruler of the whole body of analytical chemists. Can any learned profession submit to such a position? We are quite of opinion that the competency of the public analysts should be duly tested. But this task should be entrusted not to any one man, no matter how high his standing, but to a board of independent chemists, so that the interests, the prejudices, and the crotchets of each may be over-ruled by his colleagues. We may add that food analysis has not been, by any means, the speciality of South Kensington. We should fear that an examination there would prove not so much a test of the practical skill of a candidate, as of his acquaintance with and approval of certain views on notation and nomenclature which are there in the ascendant. We call upon the members of other professions to put themselves, for a moment, in the place of chemists, and reflect how they would like such regulations? We do not think that more effectual means could be taken to exclude men of standing and experience than the adoption of these proposals. They will as certainly degrade, as Mr. Allen's scheme would raise, the profession. It is fortunate that a year must elapse before any Bill, based upon the Report before us, can become law. We hope that our friends will make good use of the time, and take such steps as the interests of the profession and the good of the public demand. Such an opportunity for organisation as is now given may not re-occur; if the recommendations of the Report become law, it cannot. The close of the document is truly pathetic. The Committee "believe it will afford some consolation to the public to know that in the matter of adulteration they *are cheated* rather than *poisoned!*"

REMARKS ON A PAPER BY PROFESSOR OSBORNE REYNOLDS* "ON THE FORCES CAUSED BY EVAPORATION FROM AND CONDENSATION AT A SURFACE."

By WILLIAM CROOKES, F.R.S., &c.

Professor Osborne Reynolds, referring to my experiments on attraction and repulsion accompanying radiation, says that it is his object to prove that these effects are the result of evaporation and condensation. In my exhausted tubes he assumes the presence of aqueous vapour, and then argues as follows:—"When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp; therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near, the temperature of the pith will be reduced, and it will condense the vapour and be drawn towards the ice."

Professor Osborne Reynolds has tried an experiment with pith balls attached to a light stem of glass, and suspended by a silk thread in a glass flask. The exhaustion was obtained by boiling water in the flask, and then corking it up and allowing it to cool. The gauge showed an exhaustion of from ¼ to ⅜ of an inch. The pith balls behaved exactly as I have already shown they do at that degree of exhaustion, heat repelling and ice attracting. It was found that the neutral point varied according to whether air was present with the aqueous vapour, or whether the vapour was pure water gas. Prof. Reynolds writes—"It appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat. . . . These experiments appear to show that evaporation from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward."

It does not appear that Professor Osborne Reynolds has tried more than a few experiments, and these he says "were in reality undertaken to verify the explanation" above quoted. I have worked experimentally at the subject for some years, and the last experiment recorded in my note-book is numbered 584. From the abundant data at my disposal I can find many facts which tend to prove that Professor Osborne Reynolds's explanation of the phenomena has been arrived at on insufficient evidence.

In the first place, the presence of moisture, or of a condensable vapour, is not necessary. Besides pith, which from its texture and lightness might be supposed to absorb and condense considerable quantities of vapour, I have used movable indices of glass, mica, and various metals, and with a proper amount of exhaustion they all act in the same manner.

The following experiments bear directly on this point:—A tolerably thick and strong bulb was blown at the end of a piece of hard combustion tubing, and in it was supported a bar of aluminium at the end of a long platinum wire. The upper end of the wire was passed through the top of the tube and well sealed in: this was for the purpose of trying some electrical experiments, which, however, do not bear upon the present point. The apparatus was attached to the Sprengel pump, and exhaustion was kept going on for about two days. During this time the bulb and its contents were several times raised to an incipient red heat. At the end of the two days' exhaustion the tube was sealed off, and the bar of aluminium was found to behave exactly as it would in a less perfectly exhausted apparatus, viz., it was repelled by heat of low intensity, and attracted by cold. A similar experiment was next tried, only water was placed in the ball before exhaustion. The water was then boiled away *in vacuo*, and the exhaustion continued—with frequent heating of the apparatus to dull redness—for about forty-eight hours. At the end of this time the bar of aluminium was found to behave exactly the same as the one in the former experiment, being repelled by heat of low intensity. A similar experiment, attended with similar results, was tried with a glass index. It is impossible to conceive that in these experiments sufficient condensable gas or vapour was present to produce the effects Professor Osborne Reynolds ascribes to it. After the repeated heating to redness at the highest attainable exhaustion (the gauge and the barometer being level for nearly the whole of the forty-eight hours), it is impossible that sufficient vapour or gas should condense on the movable index, to be instantly driven off by the warmth of the finger with recoil enough to drive backwards a heavy piece of metal.

Another argument against Professor Reynolds's explanation may be drawn from the varying position of the neutral point. The fact that the neutral point for platinum or brass is close upon a vacuum, whilst that for pith is so much lower, shows that the repulsion is not due to any recoil caused by condensed vapour leaving the surface under the influence of heat. Were it so more vapour would have to be present when platinum or brass was to be kicked backwards than when pith had to moved; but the contrary obtains in all cases. The rule seems to be—the greater the density of the mass moved the higher the neutral point.

I have worked with all kinds of vacua. That is to say, I have started with the apparatus filled with various vapours and gases—air, carbonic acid, water, iodine, hydrogen, &c.—and at proper rarefaction I find no difference in the results which can be traced to the residual vapour. A hydrogen vacuum seems neither more nor less favourable to the phenomena than does a water vacuum, or an iodine vacuum.

If moisture be present to begin with, it is necessary to allow the vapour to be absorbed by the sulphuric acid of the pump, and to continue the exhaustion with repeated heating of the apparatus until the aqueous vapour is removed. When pith is employed as the index, it is necessary to have it thoroughly dried over sulphuric acid before using it, and during exhaustion to keep it constantly heated to a little below its charring point, in order to get the greatest sensitiveness.

Professor Osborne Reynolds says—"In order that these results might be obtained it was necessary that the vapour should be free from air." I find that the results take place with the greatest sharpness and rapidity if the residual gas consists of nothing but air or hydrogen.

Professor Osborne Reynolds further says—"Mr. Crookes only obtained his results when his vacuum was nearly as perfect as the Sprengel pump would make it. Up to this point he had nothing but the inverse effects, viz., attraction with heat and repulsion with cold."

As a matter of fact, I can obtain repulsion by radiation at far higher pressures than would be inferred from this quotation. The true effect of radiation appears to be one of repulsion at any pressure, overbalanced when a gas is present by some unknown cause, possibly air currents but probably not. I have already explained that the barometric height of the neutral point, dividing attraction from repulsion, varies with the density of the substance on which radiation falls, on the relation which the mass bears to the surface, and on the intensity of radiation. By modifying the conditions it is not difficult to get repulsion by radiation when the apparatus is full of air at nearly the normal pressure of the atmosphere.

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* Read before the Royal Society, June 18, 1874. (Chemical News, vol. xxx., p. 11.)

Professor Osborne Reynolds again says—"The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum was because he had then too large a proportion of air or non-condensing gas mixed with the vapour." On this I would remark that the writer, before he explained how it was I did *not* get certain results, should have made sure that what he assumed to be a fact really was so. I have not the least difficulty in showing repulsion by heat in very imperfect vacuum, when mixed vapours and gases are present.

But assuming that Professor Osborne Reynolds's explanation may account for some of the repulsion at high pressures, and in the presence of aqueous vapour, this explanation cannot be satisfactory when the vacuum is approaching absolute. The repulsion by evaporation of condensed vapour should diminish as the vapour present diminishes, and should become *nil* in a perfect chemical vacuum. I have, however, abundantly demonstrated that in all cases after passing the critical point of no action, the repulsion by radiation gets more and more apparent; it increases in energy as the vacuum approaches perfection, and attains its maximum when there is no air or vapour whatever present, or at all events not sufficient to permit the passage of an induction spark.

From the construction of my Sprengel pump I am satisfied that the vapour of mercury is not present in the apparatus.

A further argument against Professor Reynolds's explanation is that the repulsion in a vacuum is not confined to those red and ultra-red rays of the spectrum which produce dilatation of mercury in a thermometer, excite an electric current between antimony and bismuth couples, and cause a sensation of warmth when falling on the skin, but that any ray—from the ultra-red to the ultra-violet—will produce a similar effect. It cannot be imagined that a ray of cold light, filtered if necessary through thick plates of alum, can instantly vapourise a film of moisture from a plate of metal on which it is caused to shine.

For my own part, I wish to avoid having a theory on the subject. As far as the facts have led me, I think that the repulsion accompanying radiation is directly due to the impact of the waves upon the surface of the moving mass, and not secondarily through the intervention of air-currents, electricity, or evaporation and condensation. Whether the etherial waves actually strike the substance moved, or whether at the boundary surface separating solid from gaseous matter, there are intermediary layers of condensed gas which, taking up the blow, pass it on to the layer beneath, are problems the solution of which must be left to further research.

ON THE
FORMATION OF CERTAIN DOUBLE METALLIC SULPHOCYANIDES.

By WILLIAM SKEY.

Preliminary to a more extended treatment of this subject, I beg to contribute the following brief notes upon it to your valuable periodical:—

It is well known that chlorides of mercury and gold bleach the red sulphocyanides of iron: these effects appear to be due to the formation of double sulphocyanides, for I find a very pale red coloured crystalline precipitate forms when strong solutions of chloride of mercury and red sulphocyanide of iron are mixed and allowed to be at rest for some time; these crystals are nearly insoluble in water, and contain mercury, iron, and sulphocyanogen in definite quantities.

Sulphocyanide of Iron and Mercury form in long black prismatic crystals from an etherial solution of red sulphocyanide of iron and a mercurial salt; these are nearly, if not quite, insoluble in cold water, but are bleached by it, and no doubt pass into the pale coloured salt previously described. This compound is soluble in alcohol or ether, but very insoluble in acetic acid. The crystals are best washed with this acid from extraneous matters in the course of their preparation.

Sulphocyanide of Iron and Gold can be obtained from its etherial solution by spontaneous evaporation. It is finely granular, and but feebly soluble in water, more soluble in alcohol or ether; it is nearly black. Chloride of platina also decolourises the red sulphocyanide of iron if time be allowed it. But I have not been able to obtain a definite double sulphocyanide from this solution, though without doubt one forms.

Sulphocyanide of Mercury and Cobalt can be obtained in small anhydrous crystals of such an intense blue colour as to appear almost black by reflected light. Another cobalt of this nature, except that it is of a paler blue, has been formed; it crystallises in prisms of some size. Both these salts are insoluble, or nearly so, in water; they are decomposed by perchloride of iron, the red sulphocyanide of this metal forming. By evaporating a solution of chlorides of mercury and cobalt with an alkaline sulphocyanide to dryness, a red double sulphocyanide forms, which is very insoluble in water. Nickel does not appear to form a compound with sulphocyanogen and mercury, hence a process for separating it from cobalt. I may state here, as being connected with this subject, that cobalt readily forms two varieties of insoluble sulphocyanides with the alkaloids, while nickel with difficulty forms one.

Sulphocyanide of Mercury and Molybdenum falls as a flocculent red substance when the red sulphocyanide of molybdenum is mixed with chloride of mercury (aqueous solutions).

The double sulphocyanide of gold and mercury can also be readily prepared and in a crystalline state. Mercury, indeed, appears singular in regard to the number of double sulphocyanides it may form an essential element of, for, besides these just described, there is an insoluble double salt of it with cadmium and one with zinc, which I have long since announced, and also one with chromium, described by M. Rœsler as a red compound, but which I think to be light pink.

Sulphocyanide of Platinum and Ammonium forms (as is no doubt known) in small anhydrous crystals derived apparently from the octahedron, also in long prisms and flat hexagonal scaly-like masses, when platino-chloride of ammonium is digested with an alkaline sulphocyanide till dissolved, and the solution thus obtained allowed to spontaneously evaporate. These salts, as are those of the potassium salt, are of a scarlet colour and bitter; but an ammonium salt of this kind has been formed which is of a brownish red colour, crystallises in cubes, is extremely insoluble in water, and tasteless.

Perhaps some one of your numerous correspondents would kindly furnish me with the composition of one or more of these salts, or refer me to where such may be found, as I do not find any of them mentioned in the works on chemistry at my command.

Aniline, I may state, can be substituted for potassium in these salts; the compound so formed is nearly insoluble in water, but is easily soluble in alcohol or ether. The sodium salt is very soluble in water and alcohol. Sulphocyanogen thus appears to imitate chlorine very closely in its deportment with platinum and the alkalies; indeed, generally its analogies with this element seem far more decided than is the case with any of the other compounds of cyanogen or even cyanogen itself, as I shall presently attempt to show. In connection with this, I may remark that, rather singularly, the equivalent of this radical (sulphocyanogen) is a number which is very nearly the mean between that of chlorine and bromine.

Colonial Laboratory of New Zealand,
March 6, 1874.

ON SOME CHEMICAL ASPECTS OF PHYSICAL GEOGRAPHY.

By ALEX. S. WILSON, B.Sc.

(Concluded from p. 16.)

II.

During the recent voyage of the *Challenger*, a discovery has been made, the significance of which must strike every one who gives the matter even a passing thought, but to those who possess a knowledge of chemistry or geology this discovery is of peculiar interest. I therefore make no apology for directing the attention of chemists to it; indeed I cannot refrain from expressing surprise that reference should not have been made before this to a disclosure which is certain to alter existing notions as to the origin of a large section of the rock-masses composing the crust of the earth.

Professor Wyville Thomson, who has charge of the expedition, in his "Letters from the Challenger" (*Good Words*, January, 1874), records that, in sailing from Teneriffe, off the West Coast of Africa, to St. Thomas, one of the outlying West Indian islands, the soundings indicated that the bottom of the Atlantic rose into a ridge about 300 miles west of Teneriffe, and that from this, where the depth was 1500 fathoms, it sloped gently down until at 750 miles west of Teneriffe it had sunk to a depth of 2950 fathoms. From this point to within 300 miles of Sombrero the depth was pretty constant, and for 1800 miles the explorers seem to have been sailing over what geologists term a plain of marine denudation.

A remarkable relationship was found to subsist between the depth and the character of the dredgings. When worked on the 1500 fathom ridge, the dredge brought up globigerina ooze, multitudes of minute shells, and fragments of coral, the whole, with the exception of a few siliceous sponges, being composed mainly of carbonate of lime. As the depth increased, the proportion of these shells regularly diminished, until in the deep water they had altogether disappeared, and the dredgings then consisted of a fine red mud which did not effervesce with acid. This red-coloured deposit of the silicates of peroxide of iron and alumina was met with everywhere all over this vast submarine plain—everywhere it had the same unmistakable appearance; it could not, therefore, be the fine sediment brought down by rivers and carried out to sea, slowly settling in deep water, for then it must have differed in different localities; the absence of currents, too, as well as the great extent of the deposit, precluded this view of its origin. Another remarkable feature of this area was the absence of those pelagic shells which are littered in such numbers over all other parts of the bed of the Atlantic.

How, then, was this gradual disappearance of shells to be accounted for? Why was it that on this red mud area the shells of those animals that frequent surface-waters were not found, since when these creatures die their shells must inevitably fall to the bottom? Whence came this enormous accumulation of impalpable clay?

Air dissolved by water is richer in oxygen and carbonic acid than the air of the atmosphere. In air collected from just above the surface of the sea, Lewy found, by volume—

Oxygen..	21·060
Nitrogen	78·886
Carbonic acid	0·054
	100·000

Every 100 vols. of sea-water hold, on an average, 2·8 vols. of air in solution, which, in the case of surface-water, has the following percentage composition:—

Oxygen	25·046
Nitrogen	54·211
Carbonic acid	20·743
	100·000

From these two analyses, it will be seen that the amount of carbonic acid in ordinary air is, to that in dissolved air, in the proportion of 54 to 20·743. But the ratio of the carbonic acid to the total amount of dissolved gases is greater in water taken from a depth than in surface-water, as the following table from Wyville Thomson's charming book, "Depths of the Sea," will show:—

Analysis of Air held in Solution by Sea-Water at Different Depths.

	Thirty Surface.		Twenty-four Intermediate.		Thirty-five Bottom.	
	Per cent.	Proportion.	Per cent.	Proportion.	Per cent.	Proportion.
Oxygen ..	25·05	100	22·03	100	19·53	100
Nitrogen ..	54·21	216	51·82	235	52·60	261
Carbonic acid	20·74	83	26·15	119	27·87	143
	100·00		100·00		100·00	

The thirty-five samples of "bottom" water were all obtained from depths considerably under 1500 fathoms, but the following is given as the composition of air dissolved at a depth of 1476 fathoms:—

Oxygen	16·68
Nitrogen	43·46
Carbonic acid	39·86
	100·00

If, to the depth of 3000 fathoms, the amount of carbonic acid keep on increasing, relatively to the other dissolved gases, in a ratio at all comparable with that indicated by the foregoing analyses, it is easy to see that water at this depth, under such enormous pressure, must be capable of dissolving a large quantity of those solid substances which, like carbonate of lime, are soluble in water containing carbonic acid. It is clear, too, on account of both the pressure and the amount of carbonic acid being less, that water near the surface must possess a much feebler solvent power than water at a great depth. This being the case, we should expect to find more lime-secreting organisms in the shallower than in the deeper parts of the ocean; now, as has been seen, this is exactly what was found by the explorers in the *Challenger*.

Under these circumstances, Professor Thomson concludes that this vast deposit of fine red clay is neither more nor less than the insoluble portion of myriads of shells, the residue, in fact, of a chalk formation now dissolved. It might have been supposed, apart altogether from this dissolving tendency of the sea-water, that the conditions as to temperature, light, &c., at these great depths would be altogether unfavourable to life, but such is not the case; even in the red mud life abounds, although there the capacity of the water for retaining lime in solution is greater than the animal's power of abstracting it. The creatures living on this area are, therefore, either destitute of a test, or where that structure is present it is membranous, siliceous, or else, like the tubes of the annelids, simply composed of the red clay. To be relieved of any erroneous notions as to the sterility of the sea-bottom, it is sufficient to see the curiously-sculptured shell of a microscopic foraminifer, "minute, but beautiful," or to examine one of those strange-looking organisms, which the indefatigable efforts of our deep-sea explorers "have called like spirits from the vasty deep."

It appears, then, that just as the higher regions of the Alps or the Andes are buried beneath a pall of eternal snow, so the higher regions of the sea-bed are covered by a layer of greyish-white ooze, prolific in organisms whose vacated shells will one day form chalk; and just as at the edge of the snow-sheet the glacier melts away into a liquid ocean-seeking stream, so, where the chalky covering of the sea-bottom descends into submarine valleys, it dissolves into ocean, leaving behind it the red mud, like a terminal or bottom-moraine.

Suppose, now, that a geologist should come across an ancient ocean-bed undisturbed by volcanic eruptions, and undefaced by denudation, he should expect to find, on the higher levels, chalk or limestone of some sort, and as he descended into the lower plains, that the rocks would gradually lose their calcareous character, passing from chalk to argillaceous limestone, from that to a calciferous slate, and finally into slate containing no lime whatever.

There is every reason to believe that the fine red clay accumulation is but incipient slate-rock; now, though a number of contingencies render the composition of a highly metamorphosed rock uncertain, the analyses of such rocks may, in a general way, afford evidences of their origin. It may be worth while, therefore, to give the results of the analyses of some specimens.

Analyses of Slate-Rock.

	I.	II.	III.
Silica	64·32	58·80	40·40
Alumina	19·35	23·13	34·92
Ferrous oxide	—	4·18	10·28
Ferric oxide	8·07	—	—
Oxide of manganese..	0·40	0·33	0·52
Ferric sulphide	trace	0·70	0·30
Lime	—	1·14	—
Magnesia	2·30	2·16	—
Potash..	0·83	0·71	3·92
Soda	1·91	1·64	0·50
Phosphoric anhydride	0·54	0·38	0·84
Carbonic anhydride ..	—	2·88	—
Combined water, and organic matter ..	1·87	3·90	7·90
Hygroscopic moisture	0·28	0·16	0·24
	99·87	100·11	99·82
Specific gravity ..	2·78	2·83	2·86

I. is roofing-slate from the celebrated Penrhyn quarries, near Bangor. It is of a reddish purple colour, devoid of micaceous or pyritaceous particles. It rings when struck, and easily grinds to an impalpable powder quite free from gritty grains.

II. is from Easdale (Hebrides), of a dark bluish grey, pre-eminently slate, colour. Its surface has a peculiar lustre or sheen. Mica is absent, but great numbers of pyrites cubes are disseminated through the rock. The cleavage surfaces of this slate have a remarkable wavy or wrinkled appearance, resembling the ripple-mark on a sandy beach. When broken across, it does not give an irregular fracture line, but breaks in much the same way as a sheet of calc-spar would; it thus possesses a kind of double cleavage or coarse crystalline structure.

III. is from Luss, on the banks of Loch Lomond, and is of a beautiful light green colour, which occasionally passes into a delicate blue; it has a silky lustre. Slates from this quarry are not so durable as those from Bangor or Easdale: I observed, too, that the parts of this rock in the bed of a stream had become nearly white, from the water dissolving out the protosilicate of iron to which the colour is due. For the analysis of this specimen, I am indebted to my friend, Mr. H. M. Drummond.

It will be seen from these analyses that one specimen contains about 2 per cent of carbonate of lime, whilst that substance is not present in the other two. The analyses of German slates given in Bischoff's "Chemical Geology," similarly show that a great number of slate-rocks contain no carbonate of lime, whilst a smaller number contain proportions varying from a trace upwards. In a specimen from Carnarvon I found a very considerable quantity. All these three rocks, although they differ widely in appearance, contain oxide of manganese. Now, curiously enough, corals brought up from a great depth were incrusted with a black coating, which turned out to be nearly pure oxide of manganese. This may be only a coincidence, but it seems so strange that it may fairly be suspected of possessing some significance. The quantities of phosphoric acid are likewise favourable to the view that at least a portion of these rocks had an organic origin. So far, then, as the analyses go, they are not unfavourable to the theory of the origin of slate rocks now advanced by Professor Thomson and his colleagues. If, then, the great bulk of these rocks be removed from the category of mechanically-formed, into that of chemically-formed, or of organic, rocks, it will appear that geologists have been in the habit of under-estimating the importance of organic processes as geological agents. We will no longer be able to affirm with confidence, of a single grain of the commonest materials found on the earth's surface, that it has not at one time or other been associated with the manifestation of those mysterious forces which we call living. Our globe therefore resolves itself into a great charnel-house or mausoleum. Man has been called a plagiarism from oxen and sheep, but his house, whether it be of mud or of marble, is equally a plagiarism from the deserted dwellings of the Invertebrata.

The tendency of modern geology has been to break down the well-marked divisions into which the older geologists were wont to parcel out past time. The old notion, which in some measure still clings to the terms Devonian, carboniferous, cretaceous, &c., was that of a distinct period in the history of the earth. Each of these epochs was conceived to have begun and closed before the succeeding era began. In this way the world was believed to have passed through so many stages, in each of which only rocks belonging to that particular formation were deposited anywhere on the earth's surface. Thus, all the rocks of the gneiss were thought to have been formed before the lowest of the Cambrian began to be laid down, similarly with the succeeding silurian and Devonian systems. Now, however, these terms are used without reference to time, and we think of systems, widely separated according to the old method, being formed simultaneously. The chalk age was formerly supposed to have come to an end at a period long prior to man's appearance on the earth, but the researches of Carpenter, Thomson, Huxley, and others have established the "continuity of the chalk," and shown that a fauna, very similar to, if not identical with, that of the chalk, inhabits the Atlantic at the present day. The discovery of this red clay seems to point to the continuity of those ages when slate-rocks were supposed to have attained a maximum, *i.e.*, of the Cambriam and silurian formations.

Chalk deposits and coral reefs are by a process of metamorphosis converted into crystalline limestone, and by the action of sea-water even into dolomite. Granite and other so-called primitive rocks have been shown to be in many cases only metamorphosed sedimentary strata, so that we are unable to say at what particular line the recurring cycles of geological operations began ;nor on this account can we assert, except in the case of species which have become extinct, that the fauna of any preceding, differed from that of the present age.

When this red clay comes to be slate, the only traces of life it can exhibit will be derived from silica-secreting organisms of a low type, like those doubtful appearances in older slate-rocks which have been described as fossils. It is therefore altogether unwarrantable to regard this low type as the sole, or even prevailing, form of life during the time when these rocks were formed; nevertheless, there have not been wanting supporters of this view.

For aught, then, that geology can say, whilst the oldest rocks of Britain were being laid down in 3000 fathoms of water, far away silurian man may have been cultivating vines on the fertile slopes that flanked the volcanoes of the period.

Smoke and Fume Condensing Apparatus.—We understand that a model of the smoke and fume condensing apparatus manufactured by Messrs. Heslop, Wilson, and Budden, may be seen at the Royal Polytechnic Institution.

OBSERVATIONS ON THE SPECTRUM OF SHEET LIGHTNING.

By J. W. CLARK.

On Thursday evening (July 9) the sky was rather cloudy, and soon after nine I noticed the first sheet lightning, which continued without much cessation until half past eleven. My observations were made with one of Browning's five-prism direct-vision pocket spectroscopes, the results of which are as follows:—Most flashes exhibited only a bright continuous spectrum, whilst a few showed only the central part of the spectrum. The spectrum of one flash I observed consisted of only the red end of the spectrum, which was traversed with three or four bright bands. Prof. Kundt, from his observations on the spectra of lightning, states that, whilst sheet lightning yields a spectrum of bands, forked lightning generally gives a spectrum of lines. Although a large number of observations were made throughout the evening, only in the above instance was a spectrum exhibiting bands observed with any degree of certainty.

ON THE ACTION OF CARBON DISULPHIDE ON THE HYDRATES OF CALCIUM, BARIUM, MAGNESIUM, AND ZINC.

By DAVID WALKER.

When milk of lime is agitated with carbon disulphide, and then allowed to stand for a day or so, a bright orange-coloured irregular needle-shaped crystals are formed, which after the lapse of a few months will have accumulated in considerable quantities. Upon subjecting these crystals to analysis, the author found them to have a composition closely approximating to that required by the formula $CaCS_3.2CaH_2O_2+6H_2O$.

Basic calcium sulphocarbonate is quite insoluble in carbon disulphide and alcohol, but dissolves to a small extent in cold water, yielding an orange-coloured solution, which is decomposed on heating. Upon treatment with dilute sulphuric, nitric, hydrochloric, or acetic acids, it is decomposed, and yellow oily drops of sulphocarbonic acid, $(CS_3)''H_2$, separate, which decompose very rapidly.

Barium and magnesium hydrates yield soluble yellow compounds with carbon disulphide.

Zinc hydrate is not acted upon by carbon disulphide even after the lapse of many weeks.

THE INTERNATIONAL AGRICULTURAL EXHIBITION AT BREMEN.

A special and distinctive feature of this most instructive and successful Exhibition, just closed at Bremen, is the interest and the hearty co-operation shown by the German agricultural chemists: for the first time an agricultural exhibition has been something more than a mere show of live-stock, vegetable products, and agricultural implements. A whole section was reserved for "Results of Scientific Enquiry," and a meeting of agricultural chemists, physiologists, and directors of experimental stations, formed part of the programme.

Germany has many of these agricultural "Versuchs Stationen,"—experimental stations, similar to Messrs. Lawes and Gilbert's agricultural laboratory at Rothamsted; they all have been for the purpose of advancing agriculture by practical experiments and scientific investigation, which they do by following up special branches, such as physiology of animals and plants, physics and chemistry of soils, solution of technical questions, cultivation of vines, analysis of manure, seeds, fodder, &c.

At the Exhibition, fourteen of these stations were represented, who had formed their separate contributions into one collection, presenting themselves to the visitor as one exhibitor. They have modestly declined the acceptance of any prize in the shape of money or medals, but, when the Bremen Senate offered them a special prize, consisting of £75 worth of choice wines from the celebrated Rathskeller, the men of science yielded, and gladly accepted the well-merited distinction.

Much as these stations may differ in their tendency or in the special objects pursued, they all have one thing in common—a well-appointed chemical laboratory, which fact is well illustrated by the variety of chemical apparatus exhibited.

A complete collection of all works ever published on agriculture, and another of the periodical agricultural literature, open the lists of exhibits to which I wish to draw attention.

From the many subjects interesting to the chemist, I select plans of laboratories, steam apparatus, small gas-works, attached to the stations; apparatus for special purposes, such as distillation, titration, determination of nitrogen in manures, of fatty matter in milk and foods: arrangement for disintegration, such as crushing, grinding, pounding, &c.; presses; hot-air, water-, and oil-baths; safety furnaces for heating substances in sealed tubes at high temperatures, &c. Special attention is claimed for a travelling apparatus for analysis of stable air, for another demonstrating the conditions of ventilation in closed rooms, and for yet another for determining the porosity of building materials by ascertaining the amount of air forced through them.

The balance is well represented form the ordinary to the most delicate and most sensitive instrument. Sartorius, of Gottingen, exhibits a balance with an entirely new application of *torsion*, which simplifies the weighing, and does away with the "rider" altogether; the present arrangement is open to improvement, but the idea itself is a most happy thought, and, when fully worked out, is sure to be universally adopted.

The section "Physiology of Plants" contains a model of cases for vegetation experiments with different manures, photographs of plants grown in aqueous solutions of alimentary substances, showing the effect of the various agencies; other photographs represent the difference produced by feeding plants with salts containing the same radical but different acids, such as sulphates, nitrates, chlorides, &c.

A collection of "Adulteration of Seeds" forms another interesting subject. Prof. Nobbe, of Tharandt, first drew attention to this important point, which has been thoroughly exposed by many of the stations. There is a sample of beautifully got-up pure sand, carefully washed, sieved, and coloured, sold by a Hamburg firm some time ago as "clover-seed" at 13s. 6d. a cwt; also collection of seeds of weeds used for adulteration, and showing properties of pure seed and admixtures.

I must pass by the valuable section "Physiology of Animals" to say a few words on the chemical meeting. At this meeting of agricultural chemists, physiologists, and directors of experimental stations, Dr. Fleischer, of Gottingen, explained a diagram showing the movement of albuminous matter in the body of an ox, clearly demonstrating the influence of food upon the accumulation of albumen. Prof. Müller proposed in such diagrams to adopt the same colour for always the same group of substances, such as red for blood-forming compounds, blue for hydrocarbons, reminding of the iodine reaction with starch, yellow for fatty substances, and green for chlorophyll, &c.

Dr. Cannstend reported on Prof. Neubauer's experiments on "bleeding of vines," at Wiesbaden, in the course of which he collected 213 litres of vine sap, which on analysis gave, besides the salts of the soil, the whole series of organic acids from carbonic to succinic, malic, and tartaric acid; these experiments result in most important hints as to the proper time of cutting the vine, and are therefore of really national importance to all vine-growing countries.

Prof. Nobbe gives in a large diagram information on the agricultural establishments of different countries, with many details of the German ones. From this diagram, it appears Germany has 39 stations, assisted by an annual Government grant of, on the average, £400 each; many are self-supporting by analyses of soils, manures, &c., employing altogether more than 100 scientific chemists. The other countries are as follows:—Austria, 5; Belgium, 1; Italy, 12; France and England, none—the last only two private establishments.

Prof. Kühne shows a graphic illustration of influence of food upon milk as to quantity, percentage of solid matter, sugar, fat, albumen.

Prof. Wilheus has prepared a concentrated tincture of rennet, 1 c.c. of which coagulates 2 litres of milk.

Living plants grown in aqueous solutions of salts are shown, by which arrangement not only the growth of the underground parts may be watched, but also the requirements of the plants may be controlled, and most interesting pictures are given of the influence of the various substances, or rather of the more or less stunted growth of the plants owing to the absence of a given substance. The pease-plant is shown in all stages, from the poor, starving, little plant to the strongly-developed creeper in full blossom and ripe shells, 6 feet high. There are poisoning cases of clover-plants grown in pots, and fed with English ammonia manure containing sulphocyanide of ammonium.

Finally, I may draw attention to several products obtained from the washing of wool; among them are crystals of iodine, and, from a large establishment in Bohemia, the fat or oil, which is there converted into gas to light up the factory.

This rapid sketch will suffice to show that the chemical and physiological part of this agricultural exhibition was by no means despicable, and, as I think this fact should not be lost sight of in England, I have drawn up this short account, omitting many points which I should have wished to touch upon, as I am afraid I have already unreasonably drawn upon the space in your journal.

F. V.

NOTICES OF BOOKS.

Elementary Chemistry. By Dr. Bernays. London: Christian Knowledge Society.

The book opens with the widest definition of chemistry we remember to have seen:—"Chemistry is that branch of science, or knowledge, which is concerned with the nature and properties of matter." A novel feature is the introduction into the remarks on carbon of as much organic chemistry as is compatible with the elementary character of the work. The most familiar substances of daily life are commonly of organic origin, and a slight knowledge of their nature is essential to even a rudimentary acquaintance with the science. The author has boldly faced the difficulties of modern theory to beginners, and we think with considerable success. A great many interesting and some new facts are given in the course of the work, which is altogether one of the most useful and readable of the cheap manuals of elementary chemistry that have yet appeared. It is fairly illustrated.

School of Mines, Columbia College.

In these days when industrial rivalry, if not substituted for, is superadded to, the old warlike antagonism of nations, documents like this cannot be read without a lively interest. The School of Mines, whose arrangements are here described, is fully and admirably organised. In those departments with which we feel especially concerned, it has a professor of mineralogy and metallurgy; a professor of analytical and applied chemistry; a professor of general chemistry; a professor of physics; a professor of geology and palæontology; four assistants in analytical chemistry; an assistant in assaying; an assistant in general chemistry; an assistant in geology; and an assistant in mineralogy. There are five parallel courses of study—civil engineering; mining engineering; metallurgy; geology and natural history; and analytical and applied chemistry. In the three latter departments proficiency is rewarded at the end of the three years course with the diploma of Bachelor of Philosophy. The studies prescribed are exclusively scientific, no literary qualification being insisted on, save a knowledge of French and German. These languages are required merely that the candidates may be able to avail themselves of the scientific and technological literature of France and Germany.

Versuche uber die Bedentung der Aschebestandtheile in der Nahrung. Von Dr. I. Forster. München: Schurich.

This work is an enquiry into the functions of the mineral constituents of food. The author concludes from his experiments that the animal organism maintained in other respects in equilibrium, requires for its maintenance a supply of certain salts. If this supply falls below a certain amount, or ceases altogether, the system loses salts, and consequently perishes. If the mineral ingredients are withdrawn as far as possible from the diet of an adult animal, the processes of the transformation of matter, and of decomposition in the body, go on in the same manner as if ash-constituents were present in the food along with the other necessary ingredients. Gradually, however, disturbances arise in the functions of the organs which, on the one hand hinder the conversion of the food into modifications capable of assimilation, and consequently prevent the replacement of the decomposed particles of the body; on the other hand, they determine the destruction of the organism by the suppression of processes essential to life. The minimum of saline matter required for the maintenance of health was not determined. The analysis of articles of food may easily lead to exaggerated notions of the quantity of mineral matters requisite. Milk, *e.g.*, contains mere traces of iron, and yet it yields all that the young animal requires for the formation of its rapidly increasing mass of blood.

CORRESPONDENCE.

DOES SUNSHINE CHECK COMBUSTION?

To the Editor of the Chemical News.

Sir,—This question is occasionally raised, and, in the opinion of many persons, an extinguishing effect is really attributed to direct sunshine upon the domestic fire. A friend who has spent some years in South America informs me that the Indians of the Pampas will light their fires in the shade on this account, and to obtain it they will, in the absence of trees, strike tall thistle-stalks into the ground, and place a saddle-cloth over. As the habits of the Indians are generally founded on close observation, this fact may deserve attention.—I am, &c.,

G. A. Keyworth.

July 14, 1874.

Bleaching Bones and Ivory.—M. Cloez.—Bleaching is effected by exposure to the sun for three or four days in tanks filled with oil of turpentine. The objects must be supported on zinc stages at the height of a few millimetres above the bottom of the tanks.—*Les Mondes.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 25, 1874.

Note on the Movement of a Conical Pendulum, regard being had to the Resistance of the Air.—M. Resal.

Solar Radiation.—M. Desains.—Suppose a narrow valley enclosed between high mountains. From simultaneous hygrometric observations at the bottom, on the sides, and the summit of the mountains, the average hygrometric state of air in the valley may be ascertained, and so the mean weight of vapour in a given column of this air. If, at the same time, observation be made of the intensity and transmissibility of solar radiation at the bottom of the valley and on the tops of the mountains, we may deduce from these the double influence experienced by rays in their passage through an air layer of known weight, and containing a known quantity of vapour. Repeating these observations with different hygrometric states, but with the same height of the sun above the horizon, it will be possible to construct hygrometric tables, by means of which, from differences observed in the transmissibility of solar rays, we may deduce those of the total weight of aqueous vapour which the atmosphere contains in a given direction. At Paris, for nearly equal thicknesses of atmosphere, the author has found the transmissibility of solar rays vary from 0·55 to 0·77. The variations are greater than those obtained by interposing a layer of water 0·01 m. thickness in the path of direct rays.

Studies on the Transformation of Iron into Steel.—M. Boussingault.—(Extract from memoir.) The author sought to determine wherein blistered steel (the product of cementation) differed from iron; the nature and quantity of substances acquired or lost by the metal during cementation. The increase of weight in the cemented bars exceeded the weight of carbon fixed. This difference is probably due to some substances (silicium, phosphorus, &c.) from the charcoal ashes. A small quantity of iron is eliminated in the state of chloride, which is found in the charcoal. Cast steels, considered of superior quality, are really formed of iron and of carbon. In proportion as their quality rises we find the sulphur diminish and disappear. They are generally free from phosphorus; and manganese, like silicium, is present in a proportion rarely exceeding 1-1000.

Remarks by M. Berthelot.—He remarked on the *rôle* of hydrogen and of carbon in the manufacture of steel. Does not the hydrogen seem to form with the iron a combination analogous to hydrogenised palladium and the hydrides of alkaline metals lately studied by MM. Troost and Hautefeuille? and may not the graphite, which is so distinctly separated at certain points, arise from some definite compound of carbon and of iron formed on contact of these two elements, and by their direct union, like acetylen? The carburet of iron might arise from a carburet of hydrogen formed and then continually regenerated, which might act as intermediary in fixation of carbon, the iron being substituted for the hydrogen directly, as potassium, sodium, and magnesium have the property of being substituted for hydrogen directly in acetylen. The carburet of iron thus derived would explain the predominant *rôle* of carbon in steel production, a *role* restored to it by M. Boussingault's observations. The reactions which make one suspect the formation of hydride of iron commence at red heat, *i.e.*, nearly the same temperature as that at which hydrogen, usually inactive at ordinary temperatures, becomes a very active element, apt to combine directly with oxygen to form water, or with sulphur to form sulphydric acid; or with alkaline metals to form hydrides; or, lastly, with carburets of hydrogen, ethylen especially, to form hydrides also with them. All these hydrides, water excepted, take rise under the conditions of dissociation. The relation of these phenomena is of interest for chemical mechanics.

Observations on the Spectrum of Comets.—P. Secchi.—Winnecke's comet gave three bands, one in the green-blue, one in the green, and the third in the green-yellow, the first the brightest. They seemed in the position of the bands of other comets, but he could not measure rigorously. He observed Coggia's comet on May 16 and 17. The spectrum was of bands; two were very bright in the green and green-yellow, and corresponded to bands of carbonic oxide and carbonic acid. It is remarkable that all comets hitherto observed have given carbon bands. The author goes on to say he has been further confirmed in his opinion that the line 1474 of the solar corona does not belong to iron. Watching a magnificent eruption one morning, he saw the line reversed throughout the width of the spectrum, while the two lines of iron near it were reversed only throughout a very small length, and in a hardly perceptible manner. If all three lines were of iron they should be reversed throughout the same extent. The line of the corona perfectly resembled the lines of the chromosphere; it had the same intensity at a great distance from the border, and for an extent of 24°, while the lines of iron were very bright only in a small jet. P. Secchi then calls attention to an observation on one of Jupiter's satellites. When the satellite, approaching the disc, was distant from it by about its own diameter, the disc seemed to dart out so as to meet it, then immediately withdrew again. This to-and-fro movement lasted till the satellite had clearly eaten into the planet, or during four or five minutes. The satellite appears (in relation to it) as an immovable point; the movement is all on the planet's side. This atmospheric oscillation might interfere with the transit observations, and Secchi thinks it desirable to adopt some method which would diminish it, such as his spectroscopic method.

Vidal Ebullioscope.—M. Malligand and Mdlle. Brossard-Vidal.—Sugar, resins, citric and tartaric acids do not alter the boiling-point of alcohol in which they may be dissolved. This observation, made by the Abbé Brossard-Vidal, was the basis of an instrument he devised for determining the richness of alcoholic liquids. An improved form of it is here described. The indications can be had with a small quantity of the liquid (70 c.m.) and rapidly (in nine minutes).

Movement of Air in Tubes.—M. Bontemps.—(Third note.) The author here carries on the analogy to flow of electricity in a wire, applying Ohm's law.

Researches on Germination.—MM. Deherain and Laudrin.—The condensation of gases by seeds the authors find demonstrated—(1) by the existence of a small quantity of free nitrogen in them; (2) by liberation of this gas in experiments of long duration; (3) and especially by the diminution of volume produced in a confined atmosphere during the first period of germination. Now this rapid condensation by a seed of ten to fifteen times its volume of gas cannot occur without the gas losing latent heat; and it is precisely this heat which raises the temperature of the occluded oxygen to a degree sufficient for the phenomenon of oxidation to begin. The agitation is communicated to the whole mass, and the heat liberated by the combination favours a new action manifested liberation of carbonic acid.

Ammonia and Phenate of Ammonia in Treatment of Cholera and Zymotic Disease, apropos of Serpent Bites.—Dr. Declat.—The author states that ammonia and its various salts, in addition to their anti-fermentative action, fluidify the thickened blood in zymotic disease. The combination of ammoniacal gas with phenic acid, taken in draught, and subcutaneously injected (in proportions Dr. Declat specifies), is the best medicament for confirmed cholera.

New Mineral Species from the Province of Lerida.—M. Ducloux.—The author has given the name rivotite to a mineral found in small irregular masses, disseminated in a yellowish white limestone, on the western slope of the Sierra del Cadi, in the province of Lerida. The mineral is compact; its colour varies from a delicate yellowish green to a deep greyish green. The colour of its powder is grey-green. It is amorphous, of stony appearance, quite opaque, and of unequal fracture. Its hardness is between those of arragonite and fluor-spar. It is very brittle, and its specific gravity varies from 3·55 to 3·62. In almost all large specimens patches are found of green fibrous carbonate of copper. Before the blowpipe rivotite presents the following characters:—A middle-sized fragment, heated in the platinum forceps, decrepitates, but a small fragment melts and colours the outer flame green. If heated alone upon charcoal in the reduction flame it melts, forming metallic globules. No arsenical odour or antimonial vapour is perceived, and the charcoal is not coated with any characteristic deposit. If heated in a test-tube it blackens, gives off carbonic acid, and a little hygroscopic water neutral to test-paper. In a tube open at both ends the reactions are the same. With carbonate of soda upon charcoal, in the reduction-flame, it produces an opaque mass which, upon a plate of silver, does not offer the reactions of sulphur. Upon platinum wire, with borax or phosphorus salt, it dissolves with effervescence, producing the characteristic reactions of copper in both flames. The quantitative analysis yielded, in 1 grm.—

Oxide of copper	0·3950
Carbonic acid	0·2100
Oxide of silver	0·0118
Antimonic acid	0·4200
Lime	traces
	1·0368

It approaches more nearly to selbite than to any known mineral.

Action of Sulph-urea and Bisulphide of Carbon upon Argentic Urea.—J. Ponomareff.—This paper has been already noticed in the Chemical News.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 9, May 5, 1874.

Preliminary Notice on Pimaric Acid.—M. A. Cailliot.—The author describes the crystalline form and optical properties of pimaric acid, and its resolution into three parts on its alcoholic solution being raised to the boiling-point, viz., dextro-pimaric and pyro-pimaric acids, and certain intermediate products, which he reserves for further examination.

Bromo Derivatives of Pyruvic Acid.—E. Grimaux.—A lengthy paper, not suited for abstraction.

Action of Chloride of Trichloracetyl on the Amines of the Aromatic Series.—D. Tommasi and R. Meldola.—The authors examine the action of the chloride of trichloracetyl upon phenylamin.

Action of Chloride of Benzyl upon the Camphors.—Donato Tommasi.—The author examines the action of chloride of benzyl upon the camphor of the laurel tribe.

Examination of Combustibles from the Basin of the Donnetz, and of Toula (Russia).—A. Scheurer-Kestner and Ch. Meunier Dollfus.—The lignites in question contain, in comparison with coal, large amounts of ash, and of oxygen and nitrogen, which are unfortunately grouped together.

Action of Bromine on Bibromo-Succinic Acid.—M. A. Edme Bourgoin.—The bodies obtained are tribromosuccinic acid, bibromo-maleic acid, and hydride of tetrabromated ethylen.

Facts Relative to the Etherification of Ordinary Glycol.—M. Lorin.—Formic acid combines directly with glycol. On distilling the formic acid obtained by saturating the glycol with oxalic acid, the monoformin, and especially the diformin, of glycol are met with.

Formins of the Polyatomic Alcohols.—M. A. Henninger.—A reply to the preceding notice.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 18, April 30, 1874.

Action of Chloroform upon Petroleum.—The addition of 1 part of chloroform to 5 of petroleum renders the mixture incapable of combustion until the former body has been evaporated away. A litre of burning petroleum, spread out over a surface of 10 square centimetres, is extinguished by throwing upon it 50 c.c. of chloroform.

Artificial Alizarin and Madder Alizarin.—M. Chevreul.—The extension of the production of artificial alizarin must cause a loss of 30,000,000 francs to the commerce of France. For reds and rose shades, *fleur de garance* is still preferable to artificial alizarin. For violets, the shades produced by artificial alizarin are as good as those from *fleur de garance*, and are more economical. As regards fastness, the advantage is on the side of the natural product, but the difference is not sufficient to exclude artificial alizarin.

Tome xxxiv., No. 1, May 7, 1874.

The Dangers of Methylated Spirit in the Arts.—The author enumerates a variety of symptoms produced in workmen who are exposed to the fumes of methylated alcohol.

Poisoning by Nitrobenzol.—A case of poisoning from the external use of this compound, described by Dr. Limasset.

No. 2, May 14, 1874.

Mineral Manure.—A paper on the bituminous schists of the lias, said to have the power of determining the formation of ammonia and of nitric acid from the elements of air and water.

No. 3, May 21, 1874.

Presence of Arsenic.—Hager recommends the following method for the detection of arsenic in paper-hangings. A slip of the paper is steeped in a concentrated solution of nitrate of soda in a mixture of equal parts of alcohol and water, and allowed to dry. It is then burned in a porcelain capsule, water is poured upon the ash, an excess of potash is added, and the whole is boiled and filtered. Dilute sulphuric acid is added to the filtrate, and then permanganate of potash, which is dropped in slowly till the red colour disappears, giving place to a yellow under the influence of heat. If the liquid is turbid, it is filtered afresh. It is then cooled, placed in a bottle, more sulphuric acid is added, as also a small piece of pure zinc, and the bottle is closed with a stopper having two slits. In one of these is placed a piece of paper steeped in nitrate of silver, and in the other a slip of parchment soaked in sugar of lead. If arsenic is present, the former speedily blackens. The parchment serves merely for the detection of sugar of lead. H_2S P. 263

New Acid Extracted from Aloes.—Weselsky melts aloes in caustic alkali, dissolves in water, acidifies with a few drops of sulphuric acid, treats with ether, evaporates to a syrup, re-dissolves in water, treats with acetate of lead, filters, precipitates the lead with sulphuretted hydrogen, and saturates with carbonate of baryta to separate orcine. The baryta is then thrown down with sulphuric acid, and the mass remaining upon the filter is treated afresh with ether. The mother-liquor contains the acid in question.

MISCELLANEOUS.

Centennial of Chemistry, 1774—1874.—In our last issue we referred to the proposed meeting of American chemists to commemorate the discoveries of Dr. Priestley, Scheele, and others in the year 1774. A circular, from which we make the following extracts, has been forwarded to us from Dr. H. Carrington Bolton, the Chairman of the General Committee:—"The one-hundredth anniversary of Priestley's brilliant discovery now drawing rapidly near is worthy of a commemorative ceremonial, and the fact that this illustrious man spent the last years of his fruitful life in this country renders the recognition of his work by American chemists peculiarly appropriate. A *reunion* of American chemists for mutual exchange of ideas and observations would, it is believed, foster a feeling of fraternity among us, and is considered by the undersigned eminently desirable. The approaching centennial affords a fitting occasion for such a gathering. We therefore invite the chemists of America to meet at Northumberland, Pennsylvania, where Priestley lies entombed, on July 31, 1874, to celebrate by appropriate exercises this memorable epoch in the history of chemistry. Signed,—George F. Barker, Frederick A. P. Barnard, James C. Booth, G. J. Brush, G. C. Caldwell, Charles F. Chandler, William H. Chandler, J. P. Cooke, jun., Henry H. Croft, Silas H. Douglas, Henry Draper, John C. Draper, John W. Draper, Frederick A. Genth, Wolcott Gibbs, Charles A. Goessman, S. Dana Hayes, Benjamin S. Hedrick, Joseph Henry, Eugene W. Hilgard, Eben N. Horsford, T. Sterry Hunt, Samuel W. Johnson, Charles A. Joy, H. L. Kendrick, Albert R. Leeds, Abram Litton, John W. Mallet, Henry Morton, Henry B. Nason, John M. Ordway, Ira Remsen, Robert E. Rogers, Charles A. Seeley, Benjamin Silliman, J. Lawrence Smith, and Henry Wurtz. *Circular from the General Committee.*—Northumberland is situated at the junction of the north and west branches of the Susquehanna River, about sixty miles north of Harrisburg. The scenery in this region, always picturesque, is at this point exceedingly beautiful, and those visiting Northumberland will be fully repaid by the beauties of Nature alone. A short distance from the town, in a hillside cemetery, charmingly located, lie the remains of Joseph Priestley; the house he built, and in which he died, is in perfect preservation, and many relics of him are found in the town. The memorial exercises have not been definitely arranged, but it is expected that they will include—(1) An Address, by Professor Joseph Henry; (2) A Sketch of the Life and Labours of Joseph Priestley, by Professor Henry H. Croft; (3) A Review of the Century's Progress in Theoretical Chemistry, by Professor T. Sterry Hunt; (4) A Review of the Century's Progress in Industrial Chemistry, by Professor J. Lawrence Smith; (5) An Essay on American Contributions to Chemistry, by Professor Benjamin Silliman. In order to add to the interest of the occasion, a Loan Exhibition will take place during the meeting for displaying apparatus, books, manuscripts, &c., belonging to Dr. Priestley, or other objects illustrating the history of chemistry."

Metropolis Gas Supply.—Dr. Letheby, the chief Gas Examiner appointed by the Board of Trade, has recently reported to the Metropolitan Board of Works and the Corporation of London on the gas supplied to the metropolis by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the months of April, May, and June last. The examinations of the gas are made at nine testing-places in the metropolis every night, and the results thereof during the quarter were as follows:—The average illuminating power of the common gas of the Chartered Company was 17·39 standard sperm candles at Beckton, 16·95 candles at Cannon Street, and 17·08 candles at Friendly Place, Mile End; that of the Imperial Company was 16·77 candles at Carlyle Square, Chelsea, 15·82 candles at Camden Street, Camden Road, and 17·76 candles at Graham Road, Dalston; while that of the South Metropolitan Company was 16·53 candles. The cannel gas of the Chartered Company had an average illuminating power of 21·27 standard candles at Millbank, and 21·62 candles at Ladbroke Grove. Dr. Letheby reports that the gas of all the companies was fully equal to the requirements of the Acts of Parliament. As regards impurity, it is stated that the gas at all the testing-places has been constantly free from sulphuretted hydrogen, and that, with few exceptions, the amount of sulphur has not exceeded the prescribed proportions. The average quantity of sulphur in the gas of the Chartered Company was 10·6 grains per 100 cubic feet at Beckton, 10·74 grains at Cannon Street, 8·87 grains at Friendly Place, 18·79 grains at Millbank, and 17·58 grains at Ladbroke Grove. In the case of the Imperial Company, the average amount of sulphur was 20·32 grains per 100 cubic feet of the gas at Carlyle Square, 15·93 grains at Camden Street, and 18·48 grains at Graham Road; while the amount in the South Metropolitan Company was 18·26 grains, and, on ten occasions, the gas of this company contained an excess of sulphur (above 25 grains per 100 cubic feet), which the chief Gas Examiner attributes to accidental causes. The proportion of ammonia in the gas at the several testing-places was at all times below the prescribed amount of 2·5 grains per 100 cubic feet, the average quantity being less than a grain per 100 feet.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus for the manufacture of alkali. Henry Deacon, Appleton House, Widnes, Lancaster. October 15, 1873.—No. 3336. This invention consists in giving the current of flame, smoke, and other products of combustion employed in the manufacture of alkali, an upward direction before they enter the "pan," combined with the opportunity of depositing dust, and the means of causing the gases to mix; and this is effected in the following manner:—The "pan" may be raised so that the surface of its liquid contents is above the level of the axis of the "revolver," and thus the current of smoke will have an upward direction just before entering the "pan," and the end of the "pan" next to the "revolver" may be shielded from the heat by a brick wall or otherwise, against which the current of smoke impinges, and is thus mixed, and a chamber may be left between such brick wall or substitute therefor and the "revolver," into which chamber dust may deposit.

Improvements in the manufacture of manures or fertilisers. John Berger Spence and Peter Dunn, merchants, Manchester. October 16, 1873.—No. 3356. This invention consists in methods of treating natural phosphates of alumina and iron, such as those of Redonda and Los Rosques, for the purpose of rendering them more valuable as manures or fertilisers.

An improved mixture for preparing farinaceous compounds for baking. Archibald Clark, biscuit manufacturer, Glasgow. October 21, 1873.—No. 3417. This invention has for its object to improve bread, biscuits, and other baked products formed from wheat-flour or other farinaceous compounds, and, according to one modification, about 18 lbs. of linseed are steeped in 100 gallons of water for several days, and there is then added to the mucilaginous albuminous solution or liquid thus obtained 1 lb. sodium bicarbonate, 1 lb. ammonium carbonate, and 1 lb. tartaric acid. The mixture thus formed is added to the flour or farinaceous matter in quantity to give the consistency required.

Improvements in producing or preparing indigo-blue dye. Thomas Dentith, manufacturing chemist, Manchester. October 23, 1873.—No. 3446. The nature of my invention consists, first, in treating indigo with caustic soda, or sodium hydrate, or potassium hydrate; then with sulphide of tin, or sulphite of tin, or hyposulphite of tin, or metallic tin, or metallic zinc, or metallic antimony, or proto-oxide of tin (or stannous oxide of tin); and afterwards treating the above with sulphurous acid, or hyposulphurous acid, or carbonic acid, or tannic acid, or any other suitable acid. Another part of my invention consists in treating indigo with soda-ash liquor or potash liquor, then with sulphite of tin or proto-oxide of tin (or stannous oxide of tin).

An improvement in the manufacture of spirits, and apparatus for the same. Patrick Griffin, Cork, Ireland. October 23, 1873.—No. 3450. This invention consists in exposing the spirit in a divided state to the action of the atmospheric air. According to one method, the manufactured spirit is contained in a vat placed at a considerable elevation, from which it is allowed to fall in drops into a receptacle below. The process may be used to reduce the spirit to the legal strength, instead of reducing it by dilution, as now practised, before putting it into bond.

NOTES AND QUERIES.

Separation of Salts.—How can I separate a mixture of Epsom salts, sulphate of potash, and common salt?—H. S. B.

TO CORRESPONDENTS.

S. W.—The subject has already occupied considerable space. Press of more important matter renders the insertion of your letter impossible.

J. Warren.—Order the journal of Messrs. Asher and Co., Bedford Street, Covent Garden.

A. Tween.—The paper is too hypothetical for our columns.

S. R. P., Demerara.—Our publisher desires us to state that the volumes you require are out of print.

THE CHEMICAL NEWS.

Vol. XXX. No. 765.

NOTE ON THE

MEASUREMENT OF THE CHEMICAL ACTION OF SOLAR LIGHT.

By Dr. T. L. PHIPSON, F.C.S., &c.

The method employed by Messrs. Bunsen and Roscoe having been recently called in question, as leading to an exaggerated conception of the amount of chemical energy in the solar rays, Marchand[*] has had recourse to an apparatus which is merely a modification of that invented in 1859 by my lamented friend, Nièpce de St. Victor. In this apparatus light acts upon a solution of ferric chloride containing an excess of oxalic acid, and the chemical intensity is measured by the volume of carbonic acid evolved.

Many years ago I made some experiments on this subject in Paris, and described a method[†] which I believe capable of giving more accurate results than any hitherto obtained. Having discovered that a colourless solution of molybdate of ammonia in sulphuric acid became greenish blue when exposed to the sun, and colourless again during the night, and, that the amount of chemical action exerted to produce this tint may be accurately determined by a dilute solution of permanganate of potash, it suffices to operate always upon the same quantity of substance, and to expose it to the light for the same period of time, and in every respect in the same conditions, in order to possess a perfectly accurate process by means of which the problem of the chemical intensity of solar light may some day be solved in a completely satisfactory manner.

DETERMINATION OF THE ZERO POINT.

By B. F. CRAIG, M.D.

In the Chemical News, vol. xxvi., p. 249, an article is translated from a French chemical journal, on "The Determination of the True Zero of Thermometers." In it the fact is noted that thermometers almost always read a little too high; the cause of this error is set down to a systematic fault in the accepted method of determining the zero point, and a new method of procedure recommended, which, although ingenious, is troublesome and, I suspect, inaccurate.

That the method frequently used, and which the writer assumes to be always used, for determining the lower of the two fixed points of the thermometric scale, gives an erroneous result there can be no doubt; but this is the fault of the unsound manner in which an established procedure is carried out.

Following the inaccurate phraseology, "the freezing-point of water," which is used by most authors and lecturers, it is the habit to immerse the thermometer in water containing more or less broken ice. Now, the Centigrade zero, or Fahrenheit 32° point, is the temperature of the melting ice, and the water, unless in exceptional cases, is always somewhat above that temperature. If the thermometer bulb and stem is immersed in melting ice, or snow, from which the water is draining off as it is produced, the mercury will attain the exact temperature of the Centigrade zero, and will always be found to stand at the same height, as nearly as any means of observation can indicate.

I have had considerable experience in the matter, and I may state that any vessel filled with damp snow will give accurate results if the instrument is driven down in the snow up to the 32° point, and a lens placed on top of the snow to read by, provided always that there is no accumulation of water about the bulb.

Thermometers are found almost invariably to read too high, not because the original determination of the zero is always inaccurate, but because the changes which time effects in the bulb always tend towards its contraction, although there may be temporary changes in the other direction.—*American Chemist.*

NOTES UPON THE

PRODUCTION OF CERTAIN DOUBLE SALTS OF THE ANILINE BASES AND INDIGO WITH METALLIC SALTS.

By WILLIAM SKEY.

In a late communication to your periodical, I showed that aniline forms a double sulphocyanide with platinum and sulphocyanogen. I have since extended my enquiries in this direction, and find that corresponding salts of the so-called aniline bases may also be formed, and, besides, several double salts of these bases with the fixed natural ones. Thus, acetate of mauveine, warmed with bichloride of platinum till the precipitate first formed is dissolved, gives a granular precipitate when mixed with sulphocyanide of platinum and a large excess of chloride of potassium or ammonium.

Acetate of rosaniline, under similar circumstances, gives tabular hexagonal crystals of a yellowish colour and semi-metallic lustre. The variety of aniline blue now used in Judson's sets of dyes also gives a double salt of this kind, and which is very similar to that of rosaniline, only that it has a green tinge. Several others of these bases also form double salts of a like nature; they are characterised by their composition, insolubility in chlorides of potassium or ammonium, and their ready solubility in water and solutions of salts generally, including that of chloride of sodium; indeed, so great is their solubility in these liquids, that it seems they can hardly be formed except by aid of the chlorides first-named. Generally, where the platino-sulphocyanide has been formed, the corresponding platino-chloride has also been formed; these salts are uniformly granular in structure, frequently exhibiting the form of cubes.

The double mercuro-sulphocyanides of these bases are insoluble in bichloride of mercury or water, but soluble in excess of the sulphocyanide; they generally crystallise in a tabular form.

Sulpho-indigotic acid, when warmed with platino-chloride till a clear solution is obtained, gives slender crystalline plates when mixed with sulphocyanide and chloride of potassium; these have greatly the appearance of the corresponding salt of mauveine. By omitting the use of the sulphocyanide, granular blue-coloured crystals were obtained, consisting of indigo, chlorine, and platinum. Both these indigo salts require a long time to form from their solutions, sometimes not commencing this till twenty-four hours after the solution was prepared.

Double mercurial salt of indigo with sulphocyanogen has also been prepared; it is insoluble in water or bichloride of mercury, is of a pale blue colour, and takes the form of tabular-shaped crystals.

Another series of well-defined double salts of these aniline bases is that of the oxalates with those of the alkaline earths; these are generally highly crystalline, and are formed by mixing an ammoniacal solution of the base required with a solution of a salt of the alkaline earth.

Several double phosphates of this kind may also readily be formed. Thus, an ammoniacal solution of mauveine phosphate, mixed with one of magnesia, gives a double phosphate of these bases in crystalline granules; indeed, many of the acetates of these bases, when rendered alkaline by addition of ammonia, rapidly decompose ammoniacal phosphate of magnesia, producing the kind of salt just described.

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[*] Marchand, *Journ. de Chim. et Pharm.*, [4], xviii., p. 417, 1873.

[†] Phipson, *Comptes Rendus*, Paris, 1863.

Double phosphates of iron, alumina, &c., with several of these aniline bases, can be easily prepared; they are nearly or quite insoluble in water. A very good blue lake can be prepared with ferric oxide in this way. The equivalent of phosphoric acid being very much less than that of tannin (the substance now used along with alumina to fix these aniline colours for pigments), we should expect these pigments, when prepared by the aid of the mineral acid specified above, to be deeper coloured than those in which this vegetable acid enters. For the preparation of this blue pigment, iron appears better than alumina, possibly because its phosphate has a tendency to assume a similar colour to that of the pigment itself; for the same reason, the coloured metallic phosphates, such as those of copper, nickel, and cobalt, appear adapted for the preparation of certain of these coloured pigments.

Many of the insoluble salts of both lead and silver seem to combine with the corresponding ones of some of the aniline bases; for instance, the acetates, sulphocyanides, and oxalates, as also the phosphates. Chloride of silver, and even silver and gold freshly electro-plated and well washed, absorbs mauveine from its solution. This apparent metallic absorption is, however, without doubt a saline one, and indicates the presence of a thin layer of a cyanide or other salt upon the metal; that this is so further appears from the fact that freshly-ignited gold or silver do not absorb this base.

Double sulphides of rosaniline and mauveine with zinc, cadmium, silver, &c., can be formed by administering an ammoniacal solution of any of these bases to one of the metal required, and passing sulphuretted hydrogen into the mixed solution, when the double salt precipitates. They are insoluble in acetic acid.

These results show a great tendency on the part of the salts of the aniline bases to combine with the corresponding ones of the metals, forming double salts of a well-defined character, and which are frequently crystalline. From the known constitution of these bases, we should expect them to imitate in their chemical deportment that of ammonia, but, while the results here described in the main support this view, they obviously show in some respects antagonistic to it. Thus, I am not aware that we have as yet formed double oxalates of lime or baryta with ammonia, nor yet that double neutral acetates of silver or lead with ammonia have been produced. This divergence, however, is not greater than that we are frequently compelled to allow in the case of the corresponding compounds of substances belonging unmistakably to the same class.

No doubt, however, the aniline bases will differ very appreciably among themselves in their behaviour with the salts of the metals, and this accordingly as they are compounded; and it appears a useful work would be that of ascertaining the *amount* and *direction* of this. I have not the leisure as yet to follow this subject up in a proper manner—that is, by ascertaining the precise composition of the compounds here described,—but, as it appears one of some interest, I shall be pleased to learn of anyone taking the matter up.

Laboratory, Wellington, New Zealand,
April 9, 1874.

NOTES ON THE SODA PROCESS.*

By DAVID HILL.

The theory of the reaction which takes place in the ball furnace has been a bone of contention amongst chemists for many years, mainly through the fact that a large excess of carbonate of lime has been found necessary to the successful conduct of the process. It has been established by experiment that sulphate of soda heated with carbon results in sulphide of sodium and carbonic acid; sulphide of sodium presented to carbonate of lime in a heated state results in carbonate of soda and sulphide of calcium. The former reaction has been proved by Liebig, the latter by Kolb. It is a question for enquiry since the balling operation is so simple in character that so large an excess of carbonate of lime and coal are found requisite for its successful conduct.

As the result sought to be attained is the complete conversion of sulphate of soda into sulphide of sodium, and that subsequently into carbonate of soda by means of carbonate of lime, it will require but little reflection to prove that an excess of each constituent required is essential to the attainment of the desired end at each stage of the operation, and when, as in the case of coal, the constituent is liable to be destroyed by burning away through carelessness of the workmen, or otherwise, it cannot be wondered at that a very large excess is required.

The quantity of coal used in practice, is from two to two-and-a-half times that required by theory, even when the value of the coal is estimated from the fixed carbon or coke which it will yield, and some manufacturers prefer a larger excess because of the subsequent advantage in lixiviation; the excess of coal remaining as coke, by keeping the alkali waste free and porous, facilitates and enables the lixiviation to be more complete. The excess of carbonate of lime, on the other hand, which was considered until a very recent date to be essential to the formation of an oxysulphide of calcium, which at one time was considered the only insoluble compound of sulphur and calcium, has had the most light thrown upon it through the working of cylinder furnaces.

It was shown by Gossage that the excess of lime in alkali waste existed mainly as carbonate of lime; this fact of itself was sufficient to explode the oxysulphide theory. Later researches on the compounds of sulphur and calcium have shown that the monosulphide is a very insoluble compound, and it is therefore no longer necessary to assume that the insolubility of alkali waste is due to the excess of carbonate of lime, hitherto requisite for good balls. Finally, Kolb, has shown that sulphate of soda and carbonate of lime in equivalent proportions in presence of an excess of coal, yield carbonate of soda and sulphide of calcium. It thus becomes matter for enquiry, why in the face of these results, a large excess of carbonate of lime is still essential to good balling.

The proportion of lime in good balls stated in equivalents, and compared with the total soda similarly stated, has been found to be from 1·3 to 1·4 to 1,—an excess over the theoretical quantity of 30 to 40 per cent. In the first place, under any circumstances, if we wish a complete decomposition of the sulphide of sodium, we must have an excess of carbonate of lime; in the second place, as the balling is conducted in a rough way, not approaching by any means to laboratory refinement, and as the materials are not intimately mixed before being introduced into the furnace, it may happen through the bed of the furnace being imperfectly cleaned by our too fallible instruments, that one ball may have more carbonate of lime than another, it is necessary to have an excess for all, so as to cover the deficiencies of each ball; thirdly, the variability, where we use chalk in moisture and actual percentage of carbonate of lime, requires a constant excess; lastly, the system of weighing in alkali works, often in careless hands, demands a constant excess of carbonate of lime. In estimating the sum of these necessary excesses at 10 per cent—and there are other excesses peculiar to certain works, which I have not reckoned, there would still remain 20 to 30 per cent of excess to account for. The action of the cylinder furnaces has explained in a very clear way what a considerable proportion of this excess is for. In the first working of revolving furnaces, a very formidable difficulty presented itself: the balls produced were all that could be desired as far as appearances went, and in regard

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[*] A paper read before the Tyne Chemical Society.

to the ordinary laboratory testing, but they were found to be almost unacted on in the lixiviating tanks, the carbonate of soda contained in them being to all intents and purposes insoluble; after many trials, Messrs. Stevenson and Williamson patented a method of working the revolving furnaces by which this difficulty was overcome. It consisted in heating the carbonate of lime by itself, or mixed with coal in the cylinder, until a portion was converted into caustic lime, and when this stage was reached, the sulphate of soda was dropped into the cylinder, and the operation finished in the usual way. All cylinders up to this time have been worked in this way, and it has been demonstrated by this necessity, that balls, in order to burst or fall in the tanks, so as to enable the carbonate of soda to be dissolved, must contain a certain proportion of caustic lime. The lime, in slaking, swells and bursts the ball, so that practically the carbonate of soda is thrown in contact with the water in the form of powder. It will be familiar to most persons engaged in the alkali trade how difficult it is to dissolve hard and fluxed lumps of carbonate of soda, and balls produced without lime are practically in this state. To my mind, this action of the cylinders proves conclusively that the mean temperature to which the ball reaches in the cylinder is far short of that reached in the ordinary ball furnace. In fact, in the ordinary furnace, the temperature of working exceeds that at which carbonate of lime is decomposed, while in the cylinder furnace this temperature is hardly reached. If this, then, accounts for a considerable proportion of the excess of carbonate of lime required, we are brought into contact with still another source of excess, and that is the necessarily variable extent of this limeing. It has been conclusively proved, independently of theoretical considerations, that caustic lime will not decompose sulphide of sodium; hence, if in the balling process, whether in the cylinder or hand furnace, the "limeing" be carried too far, balls will be produced, giving a considerable proportion of sulphide of sodium in the liquors, which, if in considerable quantity, will be also apparent in the ball, which will present a "red" or "burnt" appearance, due to undecomposed sulphide.

Briefly, the sum of our knowledge of the balling process is this, that sulphate of soda is reduced by coal to the state of sulphide of sodium, and that this reacts upon carbonate of lime to form carbonate of soda and sulphide of calcium; but in order that the carbonate of soda may be subsequently lixiviated, it is necessary that a certain proportion of caustic lime be present in the ball, and it is highly probable that the excess of infusible lime and coke contributed to the lixiviation in another way, through imparting a stiffness to the balls when drawn from the furnace, so that the gases constantly produced in the balls do not escape freely, and thus cause them to maintain on cooling the honeycombed structure so much desired by manufacturers.

Theoretically we have to deal with pure materials—sulphate of soda, carbonate of lime, and carbon or coal; but all are more or less impure. Sulphate of soda can rarely be obtained of greater strength than 97 per cent, and the average used in the manufacture is probably nearer 96 per cent. It is hardly necessary to observe that the higher the strength of the sulphate of soda the better the yield of carbonate of soda will be, and that, too, attained at the same cost for labour, fuel, and repairs, as for an inferior sulphate. Although the strength of the sulphate may be high, the physical condition of it may be such as to prevent or at least render difficult the process of decomposition in the ball furnace. Premising that the percentage of salt undecomposed is under say 1 per cent, and that the sulphate has been well fired, as manifested by containing only a trace of acid sulphate, and further, that it is free from lime salts (peculiar to sulphate obtained from rock-salt), there should not in ordinary ball furnaces be any difficulty in obtaining that goal of manufacturers, 52 per cent ash; but the sulphate may be as free from salt, well furnaced, and of 97 per cent or upwards of real sulphate, without being able to turn out from it 52 per cent ash. The chief difficulty in this respect is the physical condition of the sulphate. Carefully prepared sulphate presents the appearance of a spongy mass which can be easily crushed by the pressure of the hand; carelessly prepared sulphate may be hard and lumpy and sometimes entirely fluxed. The two varieties may test exactly the same, but the hard, lumpy, or fluxed sulphate will almost invariably yield inferior results. I am inclined to think that the temperature of fairly worked balls never reaches the temperature necessary to melt sulphate, and that consequently hard or fluxed sulphate is in much the same position relatively in the ball furnace as unlimed cylinder balls would be in the tanks, an imperfect action taking place at the surface, but having very little penetrating power. If also the sulphate has been badly fired, the operation being completed in the ball instead of the decomposed furnace, the escaping acid vapours are partially condensed in the boiling down pans, thus contributing to reduced strength. I think this difficulty, common to practical men, of decomposing hard, or fluxed, or salty sulphate is fully explained by this view. Inferior results are always obtained, and necessarily so, from sulphate prepared from nitre cake, salt cake, or rock-salt; but it is questionable, taking into account the actual percentages of sulphate of soda in the respective sulphates, whether the results are dissimilar.

Limestone and chalk are exceedingly variable in composition, especially chalk, and that particularly in regard to moisture. Siliceous and aluminous deposits in limestone or chalk have the most disastrous effects upon the yield of soda-ash, through the tendency of SiO_2 and Al_2O_3 to form an insoluble double silicate with soda.

Of coals for mixing it may be said generally that the coal which yields a large proportion of coke at the same time that it contains a low percentage of ash, is the most profitable for mixing purposes. It is confirmed by all practical men that certain coals give the best results for mixing purposes, and the approximate analysis of these coals has always shown a high percentage of fixed carbon in coke with a variable quantity of ash; and those coals have generally given the best results which to a high percentage of fixed carbon added a high coking quality. As the greater the coking power of the coal the greater the bulk of the ultimate coke, it will not be difficult to conceive that a smaller quantity of carbon, by presenting an equal or even greater surface, may do an increased amount of work. The mixing coals in general favour contain from 65 to 73 per cent fixed carbon and from 10 to 3 per cent of ash, the remainder being volatile matter and water. The quantity of ash contained in the mixing coal is of vital importance, not only to the strength of ash, but the absolute yield of soda of 48 to 50 per cent, however manufacturers may state their results. The ash of coal consists for the most part of SiO_2 and Al_2O_3, the most pernicious impurities that can be introduced into the soda process, from the fact that they have the power to render an equivalent of soda insoluble, by forming the double silicate of alumina and soda. Some attach great importance to the absence of iron and sulphur from mixing coal, but I am inclined to think that they have very little effect upon the process. As very few practical observations, however, are without the means of explanation, I regard this as simply connected with the large proportion of ash which sulphurous coal invariably gives, and explain the indifferent results observed to the more dangerous constituents of the ash of mixing coal SiO_2 and Al_2O_3.

The condition in which the mixture is supplied to the furnace is of considerable importance. For ordinary furnaces, experience dictates that it should be ground or crushed. The difficulties connected with hard and fluxed sulphate may be to a great extent overcome by crushing or grinding. The quantity of coal required for the balling is considerably affected by the size of the lumps; generally speaking, of two coals, otherwise equal, the smallest coal will do the most execution. The same remark will apply to chalk.

I will not venture to state how good balls should be made, having already said so much on the theory of the process, but pass on to the lixiviation of the balls in the tanks. In the freshly drawn ball from the furnace, it is found that with the exception of 1 to 5 per cent of undecomposed sulphate, in the soluble part, all has been converted into carbonate of soda; in cylinder balls the undecomposed sulphate seldom reaches 1 per cent of the soluble. In fact, it is scarcely possible to get a bad decomposition in cylinder furnaces, while the occasional vagaries of ball-furnacemen, sometimes turn out balls with as much as 20 per cent of undecomposed sulphate. However good the balling may be, it may be undone altogether by careless lixiviation. By exposing to an undue temperature, or allowing to stand too long, the tank liquor may become thoroughly impregnated with sulphide of sodium and caustic soda. The loss of soda in the shape of reformed sulphate, between the ball-furnace and the tanks, by oxidation, and sulphides formed in the tanks, with good work, I am inclined to think is never less than 3, and more often 4, per cent of sulphate; this quantity, which may be regarded as the unavoidable loss, may very easily be doubled by irregularity in working the tanks. The lime, which contributes to the bursting of the balls, gives rise to the formation of caustic soda, and the quantity formed is in general greater when the liquors are weakest, and it should be an object never to let the liquors get below 50° T. on this account. It is a well known fact, that lime has little or no action on solutions of carbonate of soda of high strength; indeed, a strong solution of caustic soda will partially decompose carbonate of lime.

One of the most frequent sources of loss in the soda process is that connected with the presence of SiO_2 and Al_2O_3, and I have no doubt that caustic soda is the agent by which this insoluble compound of soda is formed. The presence of caustic soda in tank liquors is for the most part rated an impurity, excepting perhaps by the Lancashire caustic makers. Its presence certainly entails labour and expense to the maker of soda-ash. Besides the caustic soda in tank liquor, there are other impurities which individually require special treatment to remove or destroy them; these are sulphides of sodium, hyposulphide, and sulphite of sodium, a certain portion of the silicate of alumina and soda, held in solution by the caustic soda, and ferro and sulphocyanides of sodium. The only way hitherto used to effect the removal of these impurities is to boil the liquor nearly to dryness, and heat the salts in the carbonating furnace. The waste heat of the ball furnaces, which is universally used to evaporate the liquors, while it economises heat, destroys a portion of the soda; the sulphurous gas passing over the surface of the liquors is partially absorbed, and neutralises its equivalent of carbonate of soda. This loss of soda I have found to be nearly equal to 1 per cent in strength. It has been suggested to boil down the tank liquors by steam, but this has not come into use yet for various causes; one of the advantages of boiling down by steam would be to save the soda, at present neutralised by sulphurous acid.

There have been many attempts made to obtain white alkali direct from tank liquor, and even to utilise the liquor at once for making crystal soda. One of the most trifling impurities in percentage, but most important in its constituents, is the ferrocyanide of sodium, decomposed by heat in the furnace into peroxide of iron, ammonia, and carbonate of soda; the iron communicates to the carbonate a faint yellow colour, and if we removed all the impurities else from the liquor, this residuary iron would still prevent the alkali being used for the finer purposes of the glass-maker.

Up to this time there has only been one successful process for destroying this ferrocyanide in the wet way. Mr. Williamson, of the Jarrow Chemical Co., patented a process for heating tank liquor, for some time and under pressure, at a temperature of 310° F., under which circumstances the ferrocyanide is completely decomposed. This obstacle being overcome, it is very easy to suggest the means of getting rid of the other impurities. Treating the tank liquor before or after heating under pressure with carbonic acid, and allowing the separated double silicate of alumina and soda to settle, will yield a liquor capable of making white alkali of good quality. To obtain crystal soda from such liquor, it seems to me only necessary to oxidise the liquor thoroughly, and then concentrate to the crystallising strength.

I have great faith in the ultimate adoption of some process similar to that just sketched for the manufacture of white alkali and crystal soda direct from tank liquor, instead of the roundabout and costly process at present followed, and I think it probable that a modification of the balling process which I have patented in conjunction with Mr. Black, of Hedworth, will yield a tank liquor of such quality, that some of the obstacles in the way of obtaining white alkali and crystal soda from tank liquor will be to a great extent removed. The large quantity of caustic soda in ordinary tank liquors would require a considerable outlay for carbonic acid to neutralise it, which is absolutely necessary to get rid of the double silicate of alumina and soda, and the presence of a considerable quantity of sulphide of sodium would, if crystal soda had to be obtained, entail considerable cost for oxidation. The liquor obtained by this patented process must contain very little caustic soda and less sulphide of sodium than that obtained in the ordinary way.

Although these are advantages which may be reaped it white alkali and crystal soda should come to be made from tank liquor, they are simply incidental to the process, and not by any means its sole aim.

The balling process, even when conducted in revolving furnaces, can only be looked upon as a complicated and uncertain process. Its aim is not simply the conversion of sulphate into carbonate of soda, but the conversion of sulphate of soda into carbonate under such conditions that the resulting carbonate can be dissolved in the present system of lixiviating tanks. Viewing the process in this light we have thought that if the balling process were confined to the manufacture of carbonate of soda, the process would not only be simplified, but that better and more constant results would accrue.

To obtain these results we have thought it essential to dispense with the limeing process in the cylinders and heat the ball mixture so as to avoid as far as possible the formation of caustic lime, and we expect to attain this with less carbonate of lime, and much less fuel for firing than at present, doing, in fact, 25 to 30 per cent more work in the cylinders for the same outlay in fuel and repairs; and by treating the resulting balls by mechanical appliances for the purposes of lixiviation we render the lixiviation independent of temperature, and we expect that the time occupied will be diminished, both circumstances tending to diminish the quantity of sulphurets in the liquor; and, further, from the balls being practically free from caustic lime, very little caustic soda can be present in the liquors, which will consist of a solution of nearly pure carbonate of soda.

In the conduct of such a modification of the balling process it seems to me that there are only two points demanding careful attention: in the first instance we require to have an exact knowledge of the quantities of the materials in the ball mixture; and in the second instance that the mixture should be thoroughly fluxed before drawing from the cylinder without regard to the consistency of the mass as drawn. At present the working of cylinder furnaces is jealously watched, having regard to four main conditions.

(1). The mixture.
(2). The limeing as judged by observation.
(3). The limeing as judged by subsequent lixiviation in the tanks.
(4). The consistency of the mass as drawn from the cylinder, a condition which is mainly affected, however, by the speed at which the cylinder is driven.

The suitability of the liquor obtained by this process for the manufacture of white alkali and crystal soda direct, owing to the absence of caustic soda and the diminished quantity of sulphurets, has already been mentioned; the preparation of caustic soda of high strength from it and at less cost is, however, a less speculative aim.

Some alkali manufacturers aim almost exclusively at obtaining a soda-ash of high strength, and in so far as the high strength is obtained by perfect decomposition in the ball furnace, and careful lixiviation in the tanks, it is perfectly legitimate and ought to be the aim of all manufacturers; but it is wiser to strive for a high percentage of soda-ash of 48 to 50 per cent on the sulphate, as by imperfect lixiviation and leakage of red liquor, ash of high strength may be obtained without a satisfactory commercial return. Some practical men look upon a yield of 77 to 78 per cent of 48 on the sulphate, even from cylinder furnaces, with great suspicion; I do not hold this restricted view of the capabilities of the soda process, nor do I think such results necessarily fallacious, and only to be accounted for by the use of excessive weight of sulphate in the ball; still there is such a tendency amongst managers to show good results by giving good weight of sulphate in the balls, and sometimes this is given without the knowledge or connivance of the manager, that we cannot too strongly insist that in instituting a comparison of results the weight of the sulphate used should be accurately known and above suspicion. It is unfortunately only too common a complaint in alkali works, that the stock of sulphate is always found short; I believe that it is no uncommon thing for the weight of sulphate per ball, nominally of 3 cwts., to range from 3 cwts. and 7 lbs. to 3 cwts. and 21 lbs., or 102 to 106 parts of sulphate charged instead of 100. Where such practices obtain the results obtained are apt to render nugatory the importance of knowing the percentage of ash of full strength obtained on the sulphate, as against the percentage of 48 per cent obtained on the sulphate. Careful working has proved that 69 to 70 per cent of ash of full strength may be obtained from the sulphate, and where less than this is obtained it points to imperfect lixiviation and loss by leakage. Where 69 to 70 per cent is obtained, the ultimate yield of 48 per cent depends upon the original strength of the sulphate, the completeness of the decomposition of the sulphate in the ball furnace, and careful lixiviation, which consists in low temperature, rapidity, and not allowing the liquors to get too weak.

PROCEEDINGS OF SOCIETIES.

YORKSHIRE COLLEGE OF SCIENCE.

A meeting of the General Council of the College was held in the Philosophical Hall on the 17th inst. There were present Dr. Heaton (Chairman), Ald. Barran, Mr. Walker Brooke (Huddersfield), Mr. E. Crossley (Halifax), Mr. F. W. Fison (Burley), Mr. J. R. Ford, Mr. S. C. Lister (Manningham), Mr. F. Lupton, Mr. O. Nussey, Mr. G. H. Nussey, Mr. R. Reynolds, Mr. T. Salt (Saltaire), Mr. T. Scattergood, and Mr. H. H. Sales, Secretary. The Council proceeded to the election of the Professor of Geology and Mining, and the Professor of Physics and Mathematics. The claims of a large number of candidates had received careful consideration at previous meetings. The vote of the Council was unanimously given to Mr. A. H. Green, M.A., late Senior Fellow of Gonville and Caius College, Cambridge, as Professor of Geology; and Mr. A. W. Rücker, M.A., Fellow of Brasenose College, Oxford, as Professor of Physics and Mathematics.

Professor Green graduated at Cambridge in 1855, when he obtained the place of Sixth Wrangler in the Mathematical Tripos, and was shortly afterwards elected a Fellow of his College. In 1861 he was appointed one o the staff of the Geological Survey. A large portion of his time has been spent in colliery districts. He had a shar in the survey of the coalfields of Lancashire, North Staffordshire, Leicestershire, and Cumberland. The survey of the Yorkshire coalfield was carried out between 1866 and 1872, partly by himself, and partly by colleagues under his supervision. For the last five years he also held the appointment of Lecturer on Geology at the School of Military Engineering at Chatham. He is a large contributor to geological literature.

Professor Rücker was elected to an open Mathematical Scholarship at Brasenose College, Oxford, in 1867. He gained the Junior University Mathematical Scholarship in 1869, and was placed in the first class both in the first and second public examination for honours in mathematics. He obtained an open Fellowship at Brasenose College in 1871, and was elected to one of the two Mathematical Lectureships in the same College. In October, 1871, he was appointed Demonstrator in the Physical Laboratory of the University, under Professor Clifford. In the latter capacity he has had the sole superintendence of the experimental work performed by the students in the departments of mechanics and heat. He is the author of papers published in the *Proceedings of the Royal Society*.

The appointment of the Professor of Chemistry will be made this day (July 24).

The Council recorded a cordial vote of thanks to Sir A. Fairbairn for his liberal offer of £2000 provided that the sum of £60,000 was placed in the hands of the Treasurer, and resolved upon the necessary steps for raising the required amount.

NOTICES OF BOOKS.

On the Muddy Waters of the Hugli during the Rainy Season with Reference to its Purification and to the Calcutta Water Supply. By D. Waldie. (From the *Journal of the Asiatic Society of Bengal*, vol. xlii., Pt. II., 1873).

This interesting pamphlet contains an account of the construction of the filter-beds at Palta, and of the difficulties experienced in their working. The cause of this, according to the author, must be sought in a peculiarity of the water. Its slowness in clearing, whether of subsidence or filtration, appears remarkable, and is due to the extremely fine state of division of the suspended matter. To its condition the muddy waters of English rivers after an inundation furnish no parallel. The author finds that coarse, gritty sands, such as are commonly used in this country for the construction of filters, are insufficient, whilst the finer kinds are liable to choke. The advocates of coarse sands maintain that filtration depends "on the attractive power of the coarser particles of sand for the finer particles of the mud suspended in the water." Mr. Waldie, on the other hand, holds that "the most important part of the process is straining, the prevention of the passage of particles through narrow crevices between the grains of sand; next is deposition by gravity, on the upper surface of these granules, of still finer particles; and last, and least important of all, is the mutual attraction of particles of mud and sand independent of gravity."

The author refers to the power of certain salts and other soluble bodies of coagulating—if we may use the expression—the clay suspended in water, and determining its precipitation. Certain metallic salts, such as the soluble compounds of alumina, ferric oxide, and copper, possess this property in a marked degree. Alkalies and alkaline earths, and even acids, such as the nitric, hydrochloric, and acetic, exert a similar action. What is more unexpected, neutral salts, earthy and alkaline, have also this coagulating power. Mr. W. Skey, Chemist to the

Geological Survey of New Zealand, in the Chemical News, vol. xvii., p. 160, called attention to the clarifying power of the sodic, calcic, and baric chlorides. The same fact was subsequently (1870) pointed out by Schlœsing in the *Comptes Rendus*. Prof. Jevons "ascribes this coagulation of clay to the water becoming by such addition (of salts) a conductor of electricity, and the clay particles charged with electricity." Mr. Waldie, in connection with this subject, refers to the well-known fact that in washing certain precipitates the filtrate passes clear as long as saline matter is still present, but when this is removed is apt to become turbid. We may here point to the remarkable brilliance of waters naturally rich in soluble salts of lime, and of some even of the most polluted wells. Mr. Waldie finds that the Hugli water during the rainy season contains so little saline matter that suspended impurities are not precipitated. This view is supported by a number of experiments and observations.

The following table shows the approximate quantities of various salts, &c., found to produce an equal effect in clarifying muddy water:—

	Chemical equivalent.	Number of equivalents.	Absolute weight.
Chloride of sodium, or common salt	58·5	40·0	4680
Potassa hydrate	56·0	5·0	560
Soda bicarbonate	84·0	4·0	672
Acetic acid	60·0	3·0	360
Sulphuric acid	49·0	2·0	196
Calcium chloride, or muriate of lime	55·5	2·0	222
Magnesium chloride, or muriate of magnesia ..	45·5	2·0	182
Nitric acid	63·0	1·5	189
Barium chloride	104·0	1·0	208
Carbonate of lime, dissolved by carbonic acid	50·0	1·0	100
Carbonate of magnesia, dissolved by carbonic acid	42·0	1·0	84
Sulphate of lime	68·0	1·0	136
Sulphate of manganese ..	75·5	0·5	75·50
Sulphate of copper	79·5	0·2	31·80
Protosulphate of iron ..	76·0	0·15	22·80
Protocarbonate of iron, dissolved by carbonic acid	58·0	0·15	17·40
Alum	79·2	0·05	7·92
Aluminum chloride	44·8	0·05	4·48
Perchloride of iron	54·7	0·025	2·74

Chloride of potassium or muriate of potassa, sulphate of potassa, acetate of potassa, and phosphate of soda were about equally efficacious with common salt.

The importance of these researches as regards sanitary chemistry—the purification of the water-supply and the treatment of sewage—is obvious.

CORRESPONDENCE.

THE REPORT OF THE ADULTERATION COMMITTEE.

To the Editor of the Chemical News.

Sir,—I have read with the greatest interest your recent articles on the evidence given before the Adulteration Committee, and on the Report supposed to be founded on the evidence.

There can scarcely be two opinions as to the objectionable character of the proposal to make it compulsory on analysts to pass an examination at South Kensington, but we are in a fair way to see this and other absurd recommendations carried into effect, unless, by united action, we do our utmost to express our dissatisfaction.

As a proof of the opposition we have to expect, I may call your attention to the meetings recently held by the wholesale and retail grocers, and to the combined deputation which waited on Mr. Sclater Booth at the Local Government Board on Wednesday last. Among the resolutions passed unanimously at the meeting of wholesale dealers was one which "strongly urged that an appeal be allowed to the Analytical Department at Somerset House before any local convictions be enforced." This means, practically, that the local analysts are to be stultified, and no credence given to their certificates or evidence till endorsed by the chemists at Somerset House. The deputation to Mr. Sclater Booth actually demanded that the sanitary authorities should be instructed not to allow any more prosecutions for adulteration till the Amended Act had been passed.

Among the most objectionable recommendations of the Committee is that an authentic duplicate sample should be sealed by the Inspector and left with the dealer. Analysts have already suffered enough from the substitution of genuine samples for those actually sold, and the effect of such a procedure as that recommended would be to place the Analysts wholly in the power of the Inspectors.

At present, if the Inspector is corruptible, the only harm done by his bribery is that the adulterated sample never reaches the Analyst, and the dishonest dealer is not exposed. But, if the above recommendation became law, the dealer, on learning that the sample had been purchased for analysis, would hold up a bank note and beg the loan of the inspector's seal for a few minutes. Substituting a genuine article for the true duplicate, he would proceed to send the sealed and authenticated packet to one of the gentry known as "dealers' analysts," or even to a respectable chemist of repute, with the certainty of being able to upset the prosecution and seriously injure the reputation of the official Analyst. On this account, Analysts cannot protest too strongly against this fertile source of discrepancy and annoyance.

Fortunately, the Amended Act is not immediately to become law, and chemists will only have themselves to blame if they do not combine, and work vigorously in the interval, to secure a proper appreciation of the ruinous nature of some of the proposals, which seem purposely calculated to drive chemists who have a reputation to lose from the ranks of the Public Analysts.

In the absence of any special organisation for the purpose, I would call the attention of all interested in the matter to two very favourable opportunities which will shortly occur of meeting and discussing the subject in all its bearings, and, if thought desirable, of organising a deputation to the Local Government Board.

One of these opportunities will be afforded by the approaching Pharmaceutical Conference, which will be held in London on August 6th; the other by the British Association Meeting at Belfast, commencing August 19th.

I believe I am expressing the unanimous feeling of provincial Analysts when I say that we should be very glad to avail ourselves of one or both of the above chances of interchanging thoughts and opinions with each other, and I sincerely hope that those whose position gives them the power of organising the required meetings will not allow two such exceptionally good opportunities of discussing matters of common interest to slip by without an effort being made to obtain what all agree in considering so desirable.

Believing that it is only necessary to call the attention of chemists to the desirability of holding a "conference" to discuss the recommendations of the Committee, in order to have the suggestion carried into effect, I trust you will be able to find space in your columns for this letter.—I am, &c.,

Alfred H. Allen.

Sheffield, July 18, 1874.

THE SOMERSET HOUSE LABORATORY.

To the Editor of the Chemical News.

Sir,—I have read the article in your issue of the 10th, entitled "The Committee on Adulteration." The Somerset House Laboratory has always been eminently distinguished by its unaggressive character, and I am sure I should ill represent it now if I assumed an aggressive tone, or gave utterance to any expression which would tend to provoke discussion.

The Somerset House Laboratory was originally established, in the year 1842, for the purpose of suppressing the adulteration of tobacco and snuff; but, as its usefulness became apparent, its operations were extended, until at length it undertook the detection of adulterations in nearly every commodity subject to duty.

Prior to the year 1842 no special attention had been paid to the detection of adulterations in tobacco or snuff, and consequently methods had to be devised in the Laboratory for identifying the substances which were then extensively used as adulterants. In many cases these adulterants could not be discovered by ordinary chemical means, and the microscope was for the first time employed by me in detecting and identifying, in tobacco and snuff, the presence of foreign vegetable substances from some distinctive features in their structure. By the aid of the microscope, I was thus enabled to detect from time to time such adulterants of tobacco and snuff as peat-moss, starches, malt-combings, ground hard woods, fustic, the leaves and root of chicory, coltsfoot, rhubarb, dock, and other foreign leaves.

A ready and correct method was also devised for detecting and determining in tobacco the presence and amount of saccharine matter when employed as an adulterant. More recently, perfect methods have been successively devised for detecting and separating from tobacco such substances as liquorice, ordinary commercial gums, &c.

At the time the Laboratory was established the adulteration of tobacco was most extensively carried on, but by energetic measures the practice was rapidly suppressed, and the tobacco revenue largely increased. From that time to the present the Laboratory has most successfully prevented the adulteration of tobacco and snuff throughout the United Kingdom, and protected the tobacco revenue, which now amounts to upwards of £7,000,000, at a nominal annual cost.

For years the laboratory most successfully coped with the adulteration of pepper and other articles. The prevention of the adulteration of coffee is, for fiscal purposes, still under the control of the Laboratory, and it is a remarkable as well as a gratifying fact that I have observed no instance in which any analyst has detected any other adulterant in coffee than chicory, and which has now for some years been allowed by the revenue laws to be sold without restraint, either separately or mixed with coffee.

Of late years, the work of the Laboratory has included the examination of lime and lemon juice for the supply of the mercantile marine, the analyses of metals, oils and fats, drysaltery, articles of food, medicines, &c., supplied under Government contracts.

It would be too tedious and encroach too much on your space to enter into a minute account of the various successful investigations that have been made in the Somerset House Laboratory, the results of which have proved, in many cases, of the greatest importance to the state. The investigation which led to devising a method for determining the original gravities of beers and fermented liquids has been productive of great benefit, alike to the brewing and distilling trades and the revenue, and, with the concurrence of these trades, the results were made the basis for legislation.

The results obtained in an investigation of the comparative value of barley, malt, sugar, and molasses for brewing and distilling purposes were also so trustworthy that they were accepted by the trade as a proper basis for legislation.

The devising of the mixture of methylated spirit has been a marvellous success, and few persons should be better able to judge than chemists of the immense advantage that is derived from the use of duty-free alcohol, both in chemical research and also in the arts and manufactures of this country. The mixture was not only suggested by me, but the Somerset House chemists have afforded important aid, by protecting the revenue against abuses of the concession, and thus continuing the use of the mixture for the legitimate purposes for which it was originally intended.

An investigation into the distinctive characters of barley and malt was conducted in the Somerset House Laboratory with complete success, and the results were made the basis of legislation for affording facilities for the exportation of malt, and for preventing the introduction of barley into breweries.

The data upon which the changes in the law were effected for regulating the importation and exportation of tobacco and snuff, and for adjusting the duties according to the proportions of organic and inorganic matter contained in normal tobacco, were obtained in the same Laboratory, and the chemists of that department determine, for drawback of duty, the amount of normal tobacco contained in snuffs and manufactured tobaccos entered for exportation.

A most elaborate series of experiments was made in the same place to obtain the requisite data for extending Sikes's spirit tables, and the result formed the basis for new tables for assaying spirits even up to the strength of absolute alcohol.

Various other investigations have been made, and which I might enumerate, but I think I have stated sufficient to show that the department is not only fairly entitled to respect, but that the work which has been done there since its formation has been both scientific and of the greatest value to the state and the public.

Finally, I may remark that no assistant is put on the Somerset House Laboratory staff unless he has distinguished himself as a student; and I must, in justice, say that the chemical staff of that department stands pre-eminent, both for efficiency and general knowledge.—I am, &c.,

G. Phillips,
Late Principal.

71, Tufnell Park Road, N.

THE ADULTERATION ACT.

To the Editor of the Chemical News.

Sir,—I only express the general opinion of chemists in thanking you for your three admirable articles on the report of the Committee on the Adulteration Act. The proposal to subordinate the public analysts to Somerset House and to South Kensington might indeed have emanated from the office of *Mr. Punch*. Mr. Bell is doubtless a very worthy man, but my knowledge of his existence, and that the Committee proposed to make him act as censor to my work, are of the same date. In reference to South Kensington, I will only remark that, after having convicted its chemist of the discovery of five abortive methods of preparing hydrogen, I should not accept him as an arbiter in any chemical question.—I am, &c.,

J. Alfred Wanklyn.

Universities Club, Jermyn Street, S.W.,
July 20, 1874.

THE ADULTERATION ACT.

To the Editor of the Chemical News.

Sir,—The subject which you have so earnestly advocated in the last two or three numbers of the Chemical News, viz., the necessity for an Association of Analytical and Consulting Chemists, is one which every chemist must feel to be of the highest importance. The very proposal of such schemes as the "Somerset House" and "South Kensington" (both of which, by-the-bye, are very unpopular with the majority of chemists) very aptly shows how lightly the dignity of the profession is regarded. It is true several gentlemen, possessing a mere smattering of chemical knowledge, have taken upon themselves the important duties of a public analyst, and have, as would be expected, fallen into errors, and thus cast a stain upon the character of the profession generally. This clearly points the need of association among chemists, so that they may show they do not recognise unqualified persons, which will enable the public to distinguish between those who are chemists and those who, though professing to be, are not. It is to be hoped that the report of the Adulteration Committee will be beneficial in causing chemists to unite for self-protection.—I am, &c.,

W. Edwin Jack.

DOES SUNSHINE CHECK COMBUSTION?

To the Editor of the Chemical News.

Sir,—With reference to this subject, brought forward by Mr. Keyworth in the last number of your valuable journal, allow me to suggest that the decomposing influence of the solar rays on carbon dioxide and water being a well-known fact, it seems by no means improbable that these rays would have an appreciable effect in retarding the union of carbon and hydrogen with oxygen, especially in wood, and to a less extent (probably) in coal. Having (in the case of wood especially) just built up the vegetable structure, they would, no doubt, oppose every obstacle to its disorganisation. This seems partly borne out by the fact that the adverse influence of sunshine is considered of more importance when a fire is first lighted, *i.e.*, when paper and wood are the combustible bodies.—I am, &c.,

Charles W. Folkard.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 1, 1874.

Rôle of Middle Section, Polar Surfaces, and Armatures in a Magnet.—M. Jamin.—The author describes experiments which support these three propositions. (1) The number of elementary magnetic threads, and so the quantity of magnetism a magnet may contain, depend only on the middle section. (2) The opening (*épanouissement*) of the poles of these threads, or the distribution of intensities, is regulated by the form and extent of the exterior surfaces of the magnet. (3) If these surfaces diminish, the tension increases till they become insufficient to allow of the elementary poles opening out, and a portion of the two contrary magnetisms disappears, reproducing the neutral state.

Presentation of an Ingot of Alloyed Platinum and Iridium, Cast at the Conservatoire des Arts et Metiers.—Gen. Morin.—The composition was—Iron, 0·006; copper, 0·130; rhodium, 0·060; iridium, 10·370; platinum, 89·044. The mode of preparation is described. M. Deville, in presenting some osmium extracted from the residue of the manufacture of platinum, remarked on the powerfully poisonous character of osmic acid.

Observations on M. Boussingault's Studies with regard to Transformation of Iron into Steel.—M. Chevreul.—An interesting discussion followed this paper, shared in by MM. Boussingault, Dumas, and Pasteur. It referred to the action of hydrogen and carbon in production of steel. M. Pasteur expressed a wish that some of the products obtained by M. Cloëz from action of acids on metals might be submitted to polarised light, comparatively with similar products prepared with the aid of magnetised steel. It appears impossible, he says, to produce dissymmetric organic substances by our laboratory reactions, unless, perhaps, by introducing into these influences of a dissymmetrical order. He makes some striking speculations in this direction.

Researches on the Simultaneous Diffusion of some Salts.—M. Marignac.—Graham, who experimented but little with mixtures of salts, came to the conclusion that, in each case, the diffusibility of the less soluble salt was diminished. M. Marignac finds it is not always so. He has also made many experiments with solutions of two salts not susceptible of reciprocal decomposition in order to deduce their relative coefficients of simultaneous diffusibility; *i.e.*, the relation of the weights of the two salts which are diffused simultaneously when mixed in equal weights, or the proportion of this to that of two mixed salts when the mixture has been made in other proportions. He has not been able to find any general law ruling these phenomena. He makes some general remarks on his experiments, and gives a table in which the acid and basic elements of the salts studied are presented in the order of diffusibility.

Probable Fall of the Flow of Streams in the Valley of the Seine in the Summer and Autumn of 1874.—MM. Belgrand and Lemoin.—They base this prediction on the small amount of rainfall from November 1, 1873, to April 30, 1874. Whatever the meteorological character of the hot season, whether it be very wet or very dry, the hydrological features of the streams are already fixed, and from now till the middle of October the water of the Seine valley will probably sink lower than ever observed before. The authors support this by figures from previous years.

Memoir on the Bay of Saint Jean de Luz.—M. Bouquet de la Grye.—A hydrographic memoir relating to changes produced by the harbour works now in progress.

New Process for Engraving on Copper.—M. Bouquet de la Grye.—It consists—(1) in covering the plate with a thin layer of adherent silver, over which is spread a coloured varnish; (2) drawing the figures, lines, &c., with a dry point (as with the diamond in stone engraving); (3) using perchloride of iron to eat in the traces.

Note on Magnetism (continued).—M. Gaugain.—The author's previous observations have referred to soft iron; he now takes up the case of steel. He magnetised horse-shoe bars by Elias's method, passing bobbins, in which a current was flowing, to and fro together along the branches. A single couple gives better results than a battery of several couples. The magnetisation developed is very different according as an armature is kept applied or not during the operation. It depends also on the number and direction of the passes. A single pass from heel to poles develops a little stronger magnetisation than a pass the opposite way. The maximum magnetisation obtained (with the armature applied, and with twenty or thirty double passes) was nearly quadruple the magnetisation obtained without armature, and with a single pass from the poles to the heel. These are wide limits. The magnetic intensity developed depends, in general, on the initial state of the bar, and it is necessary in many cases to previously demagnetise the bar. The author's former method for soft iron is here applicable. It is long; and there is a quicker process, that of rubbing the horse-shoe bar with a soft iron bar, drawn from the poles to the heel, but the demagnetisation there is incomplete. M. Gaugain analysed the modifications thus produced. Having brought the bar to a minimum state of magnetisation, he traced the curve of demagnetisation. Then he commenced rubbing in the opposite direction from heel to poles, and traced the curve of demagnetisation. This latter was quite different; it is higher than the first, indicating that the magnetisation is increased throughout the extent of the bar when the friction is directed from heel to poles, and diminished in the opposite case.

Movement of Air in Tubes.—M. Bontemps.—(Fourth note.) Application of Ohm's formulæ continued.

Problem of Mechanics.—M. Durande.—This deals with the case of plane curves, the arcs of which—comprised within suitable limits—are traversed in the same time by a movable body submitted to the action of a certain force.

Principles of Correspondence of the Plane and of Space.—M. Zeuthen.

Flattening of the Planet Mars.—M. Amigues.—Geometers, starting with the hypothesis that the matter of the solar system has originally been fluid, have concluded that for every planet resembling a sphere the flattening must be comprised between $\frac{1}{2}\phi$ and $\frac{5}{4}\phi$ (ϕ being the relation of centrifugal force on a body at the equator to the force of attraction). Now Mars forms an exception, the flattening being more than $\frac{5}{4}\phi$. This has been urged as a serious objection to the hypothesis of original fluidity. M. Amigues seeks to remove this objection, considering that geometers have not generalised sufficiently the problem of spheroids. They have all supposed that the density of the layers diminishes continuously from the centre to the surface. Now there is no proof that all the planets have been so conditioned. We can imagine, *e.g.*, a planet cooled and hardened taking a certain form, and afterwards attracting to itself a mass of cosmic matter in its neighbourhood, which would spread over its surface like a torrent of lava. Here the superficial layers might be denser than the central. The author considers the case of a sphere composed of spherical layers, concentric and homogeneous. With regard to Mars he concludes—(1) that it has been formed at two or several different times; (2) that the mean density of the superficial layers is 1·54, that of the nucleus, that is, roughly, of the whole planet.

The Shock of Bodies.—Second note by M. Darboux.

Improvement of Electric Chronographs, and Researches on Electro-Magnets.—M. Deprez.—The author describes how he applies electro-magnets in registering-apparatus for measuring the pressure of powder in guns.

New Triangulation of the Island of Corsica.—M. Perrieu.

Muscular Spectrum.—M. Ranvier.—The observer goes into a dark room, into which light comes through a slit. The muscle preparation (consisting of one or two fibrillæ between two plates of glass) is held before the eye, the longitudinal axis of the primitive bundles being perpendicular to the slit. Two or three spectra then appear, symmetrically disposed on either side of the slit. The author describes also an arrangement in which the muscular spectrum may be used for observing the spectrum of hæmatoglobin. The spectrum is formed only by the transversal striæ, the longitudinal do not produce it. The width and extent of a diffraction spectrum is in relation to the number of striæ. Hence one may, from the spectrum of a muscle, determine the number of "sarcous elements" contained in 1 millimetre of it. The author further studied the changes in the muscular spectrum during contraction. The muscle gives spectra in all the states between complete repose and the most violent contraction.

Condition of Carbon in Cast Iron and Steel.—M. Boussingault.—In reply to M. Chevreul, the author contends that in cast iron, and in certain steels, the carbon is in two states—(1) combined with the iron and therefore invisible; (2) disseminated in the metal, either as an amorphous black powder or in brilliant crystalline laminæ, constituting the graphite of mineralogists. There is reason to believe that when cast iron is in fusion all the carbon is combined and invisible, but that a portion becomes free on cooling. On acting upon a carburetted iron with acids the state of the carbon is at once made known. The free carbon remains mixed with the insoluble residue. If no graphite is present, but merely combined carbon, there is no carbonaceous residue. The carbon is eliminated during solution, imparting a characteristic fetid odour to the hydrogen gas given off, due to volatile oily matters. This oily matter was noticed by Proust in 1799. M. Chevreul remarked that in this case chemical forces give rise to compounds analogous to those formed by vegetable organisms. More recent researches have established that these compounds are not merely analogous but identical. The author does not believe that a steel exists absolutely free from carbon.

Carbides of Hydrogen Produced by the Action of Acids upon Cast Iron and Steel.—M. Dumas.—When a metal is combined with a non-metallic body, and this compound is submitted to the action of an aqueous acid, the metal seizes the electro-negative element of the acid, or the oxygen of the water, whilst the non-metallic body and the hydrogen unite according to the proportions set at liberty. In the case of a sulphide or polysulphide, we shall have in the first case sulphuretted hydrogen, and in the second a hydride of sulphur. We may, therefore, with some probability, according to the nature of the hydrogen compound formed, characterise the metallic combination from which it is derived. The bodies, whose formation M. Cloëz has established, belong to the series which the author has designated by the symbol C_nH_n. Hence we may conclude that these compounds are derived from a carcide of iron, FeC, which, under the influence of water and an acid, gives $FeO+CH$; the latter, condensing more or less, produces polymers of the series C_nH_n. The mere meeting of carbon and hydrogen in the nascent state, in such circumstances sufficing to produce definite organic compounds, from which all definite bodies of an organic nature may be produced by known procedures of transformation, we are more than ever entitled to confound the chemistry of definite organic compound with mineral chemistry.

Observations on Natural Dissymmetric Forces.—M. Pasteur.—The author wishes that the products obtained by M. Cloëz might be submitted to the action of polarised light comparatively with similar products obtained by the aid of magnetised steel. All mineral products, and all organic bodies obtained artificially in laboratories, are void of molecular dissymmetry, and of the correlative action upon polarised light—properties which are, on the contrary, both inherent in a great number of natural organic bodies, especially such as are physiologically of the greatest importance, such as cellulose, sugars, albumen, fibrin, casein, certain vegetable acids, &c. Ordinary succinic acid, indeed, an inactive body, has yielded in the hands of Messrs. Perkin and Duppa paratartaric acid, re-soluble into dextro- and lævo-tartaric acid, and M. Jungfleisch has subsequently arrived at the same result. Still, hitherto no simple active body has been formed by the aid of inactive bodies. The author is disposed to believe that the number of paratartarics, and of re-soluble paratartarics, is considerable. The paratartarics are one of the forms of bodies which have a symmetrical plan, and they originate under the influence of actions which have nothing dissymmetrical. The opposition between the existence of chemical actions of the symmetric and of the dissymmetric order was introduced into chemical science the day when it was recognised that the physical and chemical properties of dextro- and lævo-tartaric acids, identical whenever inactive, and non-dissymmetric bodies were made to react in their presence, became, on the contrary, unlike when these acids were submitted to the influence of dissymmetric bodies. The part of molecular dissymmetry has been also introduced as a factor in vital phenomena the day when it was established that a living organised ferment easily caused the dextro-tartaric acid to ferment, but not the lævo-tartaric; and when it was found that living beings derived the carbon necessary for their nutrition from dextro-tartaric in preference to lævo-tartaric acid. Since there is dissymmetry in immediate natural principles, especially in those which may be regarded as the primordial constituents of the living cell; since vegetables produce simple dissymmetric substances to the exclusion of the inverse order; since, contrary to what takes place in our laboratories, the vegetable kingdom does not form exclusively paratartarics or simple inactives, and that probably even these latter products are only formed by secondary oxidising or reducing actions of the same order as those which occur in mineral chemistry, the author concludes that dissymmetric actions preside during life in the elaboration of true immediate natural principles. He thinks that we shall not succeed in breaking down the barrier between the organic and the inorganic until we introduce into our laboratory reactions influences of the dissymmetric order. We should endeavour by all possible means to induce molecular dissymmetry by the manifestations of forces having a dissymetric action. The author suggests the action of magnetism upon bodies in the nascent state.

Falsification of Bees'-Wax with Japan Wax.—Ch. Mène.—Japan wax has been regularly imported into Europe for some years, and is quoted at from 1¾ to 2 frs. per kilo. It is extensively used for the adulteration of bees' wax, the value of which ranges from 3¾ to 4 frs. per kilo. This fraud may be detected by the specific gravity of the sample. That of bees'-wax is 0·96931, that of Japan wax 1·00200. Yet all the mixtures containing from 50 to 90 per cent of Japan wax are lighter than bees'-wax.

Products Formed by the Action of Hydrochloric Acid upon Cast Iron and Steel.—M. S. Cloëz.—The author obtained and analysed a hydrocarbon which distilled between 118° and 124°, and presented the properties of caprylene or octylene, $C_{16}H_{16}$.

Certain Points in the History of Casein and Albumen, with reference to a Recent Note by M. Commaille.—A. Béchamp.—The author disputes the results announced by MM. Millon and Commaille, and states that he has anticipated their views on the constitution of the albumenoids.

Discrepancy of Opinion as to the Constitution of the Iron in the Blood.—MM. Paquelin and Joly.—The authors find—That calcination is a defective method for determining the iron in blood. That the results vary according to the duration of the process, and the composition of the matters analysed. That carbonisation in closed vessels, at the lowest possible temperature, is preferable.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 4, May 28, 1874.

Disaggregation of Tin.—A merchant at Rotterdam forwarded a certain quantity of tin to Moscow last winter, in the ordinary form of blocks. The metal was carried by rail during a severe frost, and arrived at its destination in the form of a coarse crystalline powder. Its outward appearance was quite unlike that of tin of good quality. The attempt to re-unite the metal by fusion failed, and gave rise to so large a quantity of stannic oxide, that the whole mass appeared as a grey powder. A sample which fell into the hands of M. Oudemans resembled in appearance molybdic sulphide, rather than tin. The metal was nearly pure, containing only 0·3 per cent of lead and iron. The author thinks that the molecular modification produced in this case was due to vibration and exposure to a low temperature.

"Petites Annales de Chimie."—J. Maumené.—An interesting paper addressed by the author to the Chemical Society of Paris, with the object of inducing that body to enter upon a formal investigation of his theories.

No. 5, June 4, 1874.

This number contains no chemical matter, save what occurs in the *Comptes Rendus.*

No. 6, June 11, 1874.

Destruction of Cockchafers.—M. d'Havrincourt.—The author collected these insects at the price of a franc per 10 litres, and having destroyed them with gas-liquor and sulphuric acid, obtained a good manure. A previous experiment, where the beetles were worked up with lime, gave unsatisfactory results.

Manures for Beet-root.—G. Ville.—The author condemns the isolated use of nitrate of soda and sulphate of ammonia. If used alone they increase, indeed, the yield but deteriorate the quality, and injure the soil. He recommends to avoid the use of animal matters, save in moderate doses, and along with chemical manure. A "complete" chemical manure gives a better crop of beetroot than does farmyard dung. In the formula of such a chemical manure the dose of nitrogen may be brought up to 80 or 85 kilos. per hectare. If dung is to be used along with chemical manures, 20,000 kilos. per hectare should be spread and buried deeply in the soil in autumn. In spring 800 kilos. of chemical manure should be given, and well harrowed in before sowing. Remove all seed plants whose roots are ill-formed, and which show less than 14 per cent of sugar.

No. 7, June 18, 1874.

Bleaching Bones and Ivory.—M. Cloëz.

No. 8, June 25, 1874.

Galenit.—This substance is described as a paint destined to replace both red and white lead. Its source is galena, qualities poor in silver being preferred, but the mode of preparation is not described.

Mineral Manure from Bituminous Schists.—M. Belinet.—A lengthy paper on the agricultural value and method of applying this substance.

Reimann's Farber Zeitung, No. 16, 1874.

This number contains a receipt for dyeing an alkali blue on garments (cotton warps); a continuation of the directions for dyeing and finishing plushes; receipts for printing black, silver-grey, dark brown, and orchil brown on woollen goods; a crimson on alpaca; a green and a magenta on shoddy; a blue pensé and a blonde on alpaca; for aniline blue on cotton yarn, with a base of oxide of tin; for a light mode grey, a reddish mode grey, a light salmon, and a red-brown on woollen yarn; for a blue, a grey, and a claret on wool.

Examination of Glycerin.—Champion and Pellet give the following instructions for testing glycerin:—Dilute with double the weight of water, and mix with acetate of lead. The formation of a deposit is a proof of impurity, which makes the sample useless for various purposes. Oxalate of ammonia should give no precipitate. Absence of colour is no proof of purity. It should be neutral to red litmus and turmeric papers. The presence of glucose—starch sugar—may be detected by adding an alkaline solution of the tartrate of copper, which produces a red precipitate of the suboxide of copper. A genuine glycerin, free from sugar, marks 31·2 of Baumé's hydrometer. If lighter it is diluted with water.

No. 17, 1874.

Rouge de Gravelotte.—This so-called new colour is merely a cochineal red, got up in the usual manner with tin crystals and oxalic acid, and "topped" in a fresh dyebeck with saffranin.

This number contains receipts for a mode grey on woollen yarn; for a pale reseda on the same material; for a Nicholson blue, a dark and a silver drap, a blue lavender, a reseda, and a light olive on wool; a slate grey on alpacas; a pansey, a pale, medium, and dark grey on calico; a wood brown, two scarlets, a yellow, orange, and light green for woollen printing. None of these receipts offer any decided novelty or advantage.

Adulteration of Orchil.—Arsenical magenta residues are mixed up with farina paste, and used for adulterating orchil paste.

No. 18, 1874.

New Method of Dyeing Ombres. (Yarns dyed in steps with shades of the same colour progressively darker and darker.)—The beck is arranged for the lightest shade, and the yarns are dyed in the ordinary manner. Part of the liquor is then let off, so that its level may read to the point where the next darker shade is to begin. The yarns are lifted, more colour is added to the beck, and the yarns are then returned and dyed, taking care that the portion intended to remain of the lightest shade is not immersed. The same procedure is repeated as many times as gradations of shade are required.

The article on hair-dyes is not adapted for our columns.

There are receipts for dyeing black and light blue on woollen and mixed doubles; for a chamois on wool; for a wood-violet on woollen cloth; a copper and a chrome black on cottons for umbrellas.

Croissant and Bertonnière's Patent.—These inventors make a new class of colours from vegetable and animal refuse of all kinds. The dyes obtained are said to fix themselves upon all kinds of fibre without the use of mordants.

Aniline Black.—Two shades can be obtained, according to Lamy, by passing through chromate of potash, or through soda. By passing through chromate of potash, soaping, washing, and passing through a weak bath of bleaching soda, a violet colour is obtained. By passing through a bath of soda, soaping, and washing, a blue shade is produced. If both swatches are steeped in dilute hydrochloric acid, at 1° Baumé and 18° C., the violet stands better than the blue, which turns green. The question arises whether these two shades are one and the same compound in different degrees of oxidation, and if the black itself is not a combination of superimposed layers of these two shades. Lamy treated pieces printed with aniline black, and taken from the dyeing-house after various terms of exposure, with chromate of potash and with soda, and obtained a number of violet and blue shades. Swatches from a fully aged piece showed, after passing through chromate, a violet-black, and if treated with soda a blue-black.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process of and apparatus for manufacturing caustic soda. Louis Bois, fils, chemist, Lyon. October 23, 1873.—No. 3452. Steam is made to pass through a series of pipes containing red-hot scrap-iron, and is thereby decomposed, the oxygen being conducted into pipes of refractory material containing carbonate of soda, which, seizing or absorbing the oxygen, is converted into caustic soda. The hydrogen of the steam is expelled by suitable means.

Improved evaporating or recovering furnace or apparatus to be used for evaporating the water in soda-lye, or liquids containing any valuable sediment or body, so that the same may be rendered fit for being again used for manufacturing purposes. Charles Stevenson, Milngavie, Stirling, N.B. October 25, 1873.—No. 3474. This invention relates to distributing the soda-lye or liquid to the action of the fire, and that by means of perforated trays, slits, rose-pipes, or whatever may best distribute or break up the said liquid into rain-drops or spray; same to be placed in position as found necessary, the soda-lye being allowed to percolate the said trays, or slits, or pipes, by its own gravity. And also forcing the liquid through said perforations by means of a force-pump, reserving the right to force in longitudinally by force-pump a spray of soda-lye or liquid over the flame, all for the purpose of breaking up the liquid and exposing it to the full action of the flame. Likewise this invention relates to the use of agitators in the furnace for the purpose of stirring up the sediment or ash which will fall from the evaporated lye or liquid, so as to expose more fully any moisture which may still remain in the sediment whatever it may be, and, at the same time, serving the purpose of a scraper in drawing forward to a bench formed in the furnace the recovered ash or sediment.

An improved method of obtaining a black pigment for paint by the utilisation of a chemical by-product or refuse, and for the machinery or apparatus connected therewith. Robert Owen, Bowdon, Chester. October 28, 1873.—No. 3502. The by-product or refuse for manufacturing the black pigment is the residue arising from the manufacture of prussiate of potash, the residue being commonly called animal charcoal or carbon by the manufacturers. This residue contains ashes or gritty matters enveloping or mixed among the fine particles of carbon or charcoal, and the object of this invention is to separate these coarse and fine matters in the most efficient and economical manner, for the purpose of enabling the finer particles to be combined into a black pigment, or used as a powder, which, when worked up with boiled linseed oil and other matters used by painters, produces a cheap and durable black paint; but bluish shades can be obtained by an admixture of any of the drugs used by dyers for the purpose of having blue tints, and for the purposes of separation and grinding there are tanks, a separating- or dividing-trough, a filtering-trough, and for grinding the blocks a conical grinding-mill.

Improvements in the process of, and kilns for, burning lime, bricks, tiles, and other articles, and for the calcination of minerals. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. October 28, 1873.—No. 3505. The object of this invention is the economy of fuel in lime- and brick-burning, and other analogous processes, and in the roasting of ores, such as iron ores. This object is accomplished by combining the principle of the ordinary running lime-kiln or ordinary brick-clamp, in which the mineral and fuel are interstratified, with the flare principle of burning, the flare being produced by the gaseous fuel of coal, and the coke which results after the gases are expelled from the coal being employed for the layers of fuel, which are mixed with the mineral or article to be operated upon.

Improvements in the construction of thermo-electric batteries or piles, and in the application of the electric currents derived therefrom through the medium of a novel arrangement of electro-magnets. Camille Alphonse Faure, Trafalgar Square, Charing Cross, Middlesex. October 30, 1873.—No. 3540. The novelty of the invention consists in arranging two plates or cylinders in such a manner that there will be an opening or annular space formed between them, which is filled with sulphuret of lead or "galena;" one of the plates or cylinders is kept hot by artificial means, and the other kept cool by the application of water. The two plates or cylinders form the poles of the thermopile, which are connected together by a suitable conductor, and which receives the electro current passing through the "galena," and transmits it to a magnet, around the cores of which a number of separate isolated strands of wire are wound, each strand being separately connected with the poles of the battery or thermopile, thereby producing electro-magnetic power, which actuating an armature through a series of "break" and "make" currents, a revolving motion to a shaft is given which may be employed for driving purposes.

Improvements in apparatus for utilising sewage. John Flewitt Milnes, Park Valley, Nottingham. October 31, 1873.—No. 3541. The improvement consists in constructing a series of pits along the sewer bottom. The top of each pit is provided with a grating, each succeeding grate being a finer guage than the preceding one; over each pit the crown of the sewer has an orifice, through which is passed a tube, the bottom of which fits and rests upon the kerb of the pit, while the top conforms to the shape of the orifice in the crown of the sewer, so as to prevent the escape of gases. The solid sewage deposited in the pit is emptied through the tube by means of buckets, Archimedean screws, or equivalent contrivance.

Improvements in removing sulphur from caustic soda or ammonia when containing sulphides. Ernest Smith, manufacturing chemist, Glasgow. November 3, 1873.—No. 3573. In the case of soda, the liquor has suspended in it granulated zinc, with which it is agitated until all the sulphur has combined with zinc. The zinc that is unacted on is then removed, and the zinc sulphide settles to the bottom. In the case of ammonia, the same process is adopted, or a solution of ammoniacal salt may be put in a still with the lime necessary for rendering the ammonia caustic, and with a quantity of ferrous sulphate, whereupon the caustic ammonia may be directly distilled over free from sulphur.

Improvements in obtaining colouring matters and other substances from certain waste materials resulting from the manufacture of gas. John Rowley, manufacturing chemist, Camberwell, Surrey. November 4, 1873.—No. 3588. This invention relates to the production of blue and other colouring matters, and other substances, from certain waste materials obtained from the purifiers employed in the manufacture of gas.

Improvements in the manufacture of soaps applicable for use as lubricants and for other purposes. Edouard George Peter Thomas, Star Chemical Works, Brentford, Middlesex. (A communication from Jules Persoz, chemist, Rue des Ecoles, Paris). Nov. 5, 1873.—No. 3603. This Provisional Specification describes dissolving oils or fatty bodies in a heavy oil, and forming soap in the midst of the liquid mass by the addition of alkali. Sodic and potassic soap are made with a light oil instead of a heavy oil. The light oil is removed by distillation.

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Vol. XXX. No. 768.

THE PUBLIC ANALYSTS, AND THE REPORT OF THE ADULTERATION OF FOOD COMMITTEE.

As will be seen from the report of the meeting held at the Cannon Street Hotel on Friday last, the Public Analysts, to a man, utterly rejected the proposal of the Select Parliamentary Committee, that all disputed cases should be referred to the Inland Revenue Laboratory at Somerset House. In addition to the arguments against this scheme, which we have already laid before our readers, it was urged that the award of any referee, however qualified, should be made on oath, and should be liable, like all other evidence, to be tested by cross-examination. Neither the Local Government Board, nor Parliament itself, can invest any chemist with the infallibility which the suggestion of the Select Committee would require.

We feel bound to congratulate the Public Analysts on their good taste and moderation. The contemplated "aggression" was rejected without the introduction of personalities, and without any desire to carry the war into the enemy's country. It is not unreasonable to hope that the number of disputed cases will be, in future, much reduced. The methods for the analysis of articles of food are undergoing great and rapid improvement. The vexed question, "What is an adulteration?" which has occasioned no small diversity of opinion, will receive an approximate solution. But, if referees are needed, there can be no doubt that the selection should be made by the Public Analysts themselves. Let them, we say, have the right of choosing a few men of undisputed standing and of known special experience, and let the services of these be called in if a disputed case should arise.

As little favour was shown to the other proposal, that every candidate for the office of Public Analyst should have passed an examination at South Kensington. Whilst it was fully admitted that the exclusion of unqualified men was essential, it was contended that the proposed scheme would give a monopoly of patronage to one particular institution, or to its head for the time being, which would be grossly unfair to other schools and to the pupils of private analysts, and which would ultimately lead to abuses. A Committee chosen by the Public Analysts themselves would be the most suitable body to test the qualifications of every future candidate. This is, we think, indisputable, and it is in harmony with general precedent. Who, for instance, decides whether a young man is fit to be admitted as a Member of the Pharmaceutical Society, and, as such, to be allowed to compound and dispense medicines? Not a Government department, not some one person holding some particular public appointment; but a body of examiners chosen by the Council of the Pharmaceutical Society. Why, in like manner, should not the Public Analysts, or their Council, appoint examiners to test the fitness of candidates; and why should not the law recognise and uphold their authority, as it does in parallel cases?

This brings us to the most interesting consideration in connection with the late meeting—the professional organisation of analytical chemists. Such an organisation we have long contended for. We hold it necessary for the exclusion of incompetent and dishonourable intruders, for the maintenance of a strict professional etiquette, and for the elevation of the professional status. We see in it the only means to do away with the scandal of "high" and "low" analyses, made respectively to sell by or to buy by. Therefore we rejoice when we see any movement, however slight, in the required direction. Still we do not conceal from ourselves that the Committee appointed by the meeting on Friday last to arrange the preliminaries of the proposed Association have taken in hand a most arduous task. The first step is almost as difficult as was placing the first stone of the dome of St. Peter's. At the very outset the Committee are met by the question, Who is entitled to the membership of the proposed Association? Are they first to examine each other, and then extend the operation to their constituents? Or are they to assume that all who are already in practice are competent, and merely to lay down rules to exclude all unqualified persons for the future? The latter procedure, with all its drawbacks, seems the only practicable measure. It is what was followed in the case of the medical profession. When the modern Acts for regulating the standards of medical education were passed, it was enacted that all persons in practice at that time should be recognised without further enquiry, but that all new candidates should give proof of their satisfactory qualification in manners prescribed. It is difficult to see how the Committee of the proposed Analysts' Association could do better than follow this precedent. When once the Association is formed, incompetence will begin to feel uncomfortable, and will gradually be eliminated.

We notice, however, with regret that the Association proposes confining its operations to the analysts of food. This, we think, is a mistake. It would surely have been better to have invited all analytical and consulting chemists to come in and join the movement. At present the Association will represent, not an entire profession, but merely the fragment of one. In other departments, among metallurgical, agricultural, and tinctorial chemists, there is the same need for organisation, and attempts have been made to supply the want. The broader the basis of the Association, the greater will be its influence with the public, with the press, with the scientific world at home and abroad, and with Government. We must, therefore, suggest to the Committee, who have now begun their labours, to consider whether the union of the whole profession should not be attempted. A "Public Analysts' Association" will be a good thing, both for its members and for the public; but an "Analytical and Consulting Chemist's Association" would be many degrees better. If, however, the latter is not immediately practicable, let us by all means accept the former as an instalment.

We were much pleased with a few remarks made at the meeting on the necessity of the Public Analyst taking up a perfectly neutral position, and not seeking to do the work either of an attorney or an inspector. It would greatly strengthen his position with the public if he were, whenever possible, kept in ignorance of the very name of the tradesman whose wares he is examining. We shall endeavour to return to this subject, to examine further certain of its more prominent features.

ON CHRYSENINE.

By T. L. PHIPSON, Ph.D.

This is a solid base which I have extracted from crude chrysene. A certain quantity of chrysene is placed in a deep porcelain dish, and twice its volume or rather more of boiling water is poured upon it so as to render it as fluid as possible. The water is then acidulated with hydrochloric acid and the mixture stirred well together for some time; it is then allowed to cool and the acid liquid separated and filtered. It is a liquid of a bright yellow colour, from which ammonia precipitates the base in an impure state, in the shape of a brick-red precipitate, more or less impregnated with quinoleine and other bases, and smelling strongly of that substance. It is transformed into sulphate and re-precipitated, and this operation repeated once or twice. Finally the concentrated aqueous solution of the sulphate, which is dark orange with a red fluorescence, is exposed to that these bodies are not salt in the common acceptation of the word, but compounds analogous to the alkaline hydrates. From the action of pyrogallol we may learn whether any given substance really fulfils the functions of an acid, and if, consequently, its neutral compounds with bases may be ranked in the class of salts. On the other hand, the property of the reddish brown pyrogallo-ferric liquors of changing and giving a black precipitate of tanno-melanate of iron; that of the ferro-potassic tartrate and ferric acetate blues, which leads to the same result, either slowly, or instantly on boiling, suggests the idea of an application to dyeing and calico-printing. In dyeing, the pieces or yarns must be kept moist, so as to produce insolubility and fix the colour. In case of printing it will be found advantageous to cause the pyrogallol to act upon a mixture of acetate of soda and iron mordant, free from excess of acid, thicken, print, and steam. The black is not a good shade, but may serve as a base for compound colours in steam styles.

Part Played by Salts in the Action of Drinking-Waters upon Lead.—M. Fordos.—A detailed account of the action of certain salts in retarding or promoting the action of water upon metallic lead. The salts examined were sulphate of soda, chloride of sodium, chloride of ammonium, nitrate of ammonia, sulphate of lime in saturated solution, saturated solution of sulphate of lime mixed with common salt, and sulphate of magnesia. In all these cases the lead was attacked, and small quantities of it were found in solution.

Extraction of Boracic Acid from Bromatro-Calcite.—This mineral contains—

Boracic acid	42
Soda	8
Lime	13
Water	37
	100

It is found in several districts of the state of Nevada. To extract the boracic acid the mineral is evaporated with sulphuric acid in leaden pans to the consistence of a thick paste, which is then run out, and which hardens as it cools. It is then placed in cast-iron cylinders, which are heated to redness, whilst a current of steam passes through. The boracic acid is volatilised with the steam, and condenses in chambers lined with lead. To remove the sulphuric acid the vapours pass at first through a layer of coke, arranged in the upper part of the cylinders, which educes the sulphuric acid to sulphurous.

Improvement of Old Zinc White.—M. A. Speidel.—If kept for a long time zinc-white becomes granular and gritty, and useless for painting. It may be restored by ignition in an earthen crucible.

Patera's Mercurial Furnace.—M. Kustel.—This is, in principle, a muffle furnace. The ore must be previously pulverised; but the expense of this operation is unimportant if compared with the improved yield of metal. In the retort process, as used at Idria, a loss of 37 per cent of mercury is admitted, but if the yield is compared with the actual composition of the ore, the loss will be found greater by 12 per cent. Patera considers that his process yields 84 per cent of the mercury present in the ore. The author has examined the residues, and found them completely free from mercury. The temperature in the experiment was kept all along below redness.

Action of Mineral Acids upon Sugar in Presence of the Organic Salts Contained in the Juice of Beet-Root.—M. E. Feltz.—The author found in his experiments the inversion of sugar less considerable than he had been led to expect.

Determination of Grape-Sugar in Beet-Root.—M. G. Krause.—Independently of cane-sugar beet-root contains grape-sugar to the extent of about 0·1 per cent. In spring, when the root has remained underground during he winter, the proportion may rise to 0·3 or 0·4 per cent. A moist season is favourable to its production. To determine the amount, 100 c.c. of beet-root juice are shaken up with 10 c.c. of basic acetate of lead. The mixture is filtered, washed, and the mixed filtrate and washings freed from excess of oxide of lead by carbonic acid. An excess of this gas must be avoided to obviate even the slightest acidity of the liquid. The neutral acetate of lead present is then thrown down with carbonate of soda, and the liquid is boiled for a quarter of an hour to coagulate the albumen. It is filtered, heated to 100°, and mixed with Fehling's test in slight excess. After digestion for one hour in the water-bath, the suboxide of copper formed is collected, and converted into cupric oxide by ignition in contact with air. The weight of this oxide, multiplied by the factor 0·4534, gives the weight of glucose present in the juice. It is necessary to operate rapidly, and carefully avoid acidity in the liquid.

Determination of the Yield of Crude Sugar.—M. Scheibler.—To value a sample of crude sugar, the author treats it with alcohol mixed with acetic acid, and already saturated with sugar. The apparatus consists of two flat-bottomed flasks. The first, of 50 c.c. capacity, has a stopper cut sloping to admit of the circulation of air. It is perforated with two holes, through which pass a short tube designed for the introduction of the exhaustion liquids, and a tube reaching to the bottom, and widened at its lower end, over which is stretched a piece of flannel to serve as a filter. This filter-tube is externally connected with the second flask by means of a caoutchouc tube. The latter, 100 c.c. in capacity, is fitted with a tube for connecting with the former flask, and another tube, short, and fitted externally with a caoutchouc tube and a pinch-cock. This flask serves as an aspirator when a partial vacuum is made in it. A weighed quantity of the sugar under examination is placed in the first flask, and successively exhausted with the following liquids:—(1) Alcohol at 85 per cent, containing 50 c.c. of acetic acid per litre, and saturated with pure sugar; (2) alcohol at 92 per cent; (3) alcohol at 96 per cent, both saturated with sugar. These three liquids are kept in bottles along with an excess of sugar-candy. Finally, the sugar is washed with a few drops of absolute alcohol, then dissolved in water, and examined with the saccharimeter.

Utilisation of Waste Soap-Lyes and Oily Liquors.—M. H. Vohl.—Instead of separating the fatty matters from the water by means of mineral acids, the author proposes to treat them with salts of magnesia. Magnesian soaps are thus formed, containing 60 per cent of fatty matter, and which may be used in the manufacture of gas for lighting purposes.

Contribution to the Theory of Bleaching.—P. de Wilde.—The material, suitably divided, is boiled with water, taken out, allowed to drain, and then exposed to the action of gaseous chlorine. After some time it is boiled in water. If sprinkled with water containing caustic soda, equal in quantity to the tenth of the original weight of the material, it softens, and is then easily and finally bleached with chloride of lime at 1° B. The bleached fibre has a silky lustre.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 8, May 11, 1874.

Coniferin and its Conversion into the Aromatic Principle of Vanilla.—Ferd. Tiemann and W. Haarmann.—The authors commence with describing the preparation of coniferin, the juice scraped from recently felled and barked pine trees in spring-time being the raw material. It is then split up by digestion at a gentle heat with a small quantity of emulsion. The vanillin thus obtained is at first inodorous, but in course of time acquires a faint odour of vanilla. Coniferin, $C_{16}H_{22}O_8$, furnishes the following series of products:—$C_{10}H_{12}O_3$ (grape-sugar, $C_6H_{12}O_6$); vanillin, $C_8H_8O_3$; protocatechuic acid, $C_7H_6O_4$; pyrocatechin, $C_6H_6O_2$.

On Hydrargyramids.—A. Oppenheim and S. Pfaff.—The authors obtained a phenylated hydrargyracetamid $(C_2H_3ONC_6H_5)_2Hg$, which crystallises from alcohol in small colourless needles, melting at 215° with partial decomposition.

Contributions to the History of the Terpenes.—A. Oppenheim and S. Pfaff.—The authors endeavoured to throw light upon the constitution of the terpenes—hydrocarbons of the formula $C_{10}H_{16}$—by converting them into cymols, $C_{10}H_{14}$, and determining the nature of the latter by the study of their oxidation-products. They report on the results obtained with tereben, borneen, geranien, and eucalypten.

Compounds Connected with "Stenhouse's Substance," Urethan Derivatives.—C. Bischoff.—The author examines the action of acetal, mono-chlor-acetal, chloral, bromal, croton-chloral, valeraldehyd, mono-chlor-valeral, and oil of bitter almonds upon urethan.

On Oxæthen-Toluydin.—Eugene Demole.—The author describes the preparation and properties of this compound, $C_9H_{13}NO$; its double platinum-chloride, oxalate, and acid sulphate; its behaviour with CH_3I when methyl-oxæthen-toluydin is obtained; the double platinum-chloride of the latter, and its behaviour with CH_3I; and the formation of the double chlorides of platinum and of gold with dimethyl-tolyl-oxæthen-ammonium-chloride. He further describes dioxæthen-toluydin, and the products obtained by the dehydration of oxæthen-toluydin.

New Method for the Expeditious Preparation of Glycol.—Eugene Demole.—102 parts of dry acetate of potash, 195 of æthylen bromide, and 200 of alcohol at 80 per cent, are heated to a boil for sixteen to eighteen hours in a flask provided with a cohobator. The liquid is filtered from the bromide of potassium and distilled, first in the water-bath, and then in the oil-bath.

Communications from the Laboratory at Greifswald.—H. Limpricht.—These communications relate to a new nitro-toluydin, and to benzol-nitro-toluydin.

Ammonia-Soda Process.—Rud. Gunsberg.—A criticism on Prof. A. Bauer's paper on the same subject (*Berichte*, Heft 5, p. 272). The author finds from his experiments that the most advantageous yield of soda by this process depends on regulating the respective proportions of common salt, ammonia, and water, so that at the end of the transformation there may remain a saturated solution of sal-ammoniac. The whole process hinges upon degrees of solubility.

Constitution of Hyposulphurous Acid.—Hans Bunte.—A hypothetical paper.

Constitution of Terebinic Acid.—R. Fittig and B. Mielck.—An examination of the formulæ proposed for certain derivatives of terebinic acid.

On Oroselon.—H. Hlasiwetz.—With reference to the paper by v. Gorup-Besanez (*Berichte*, Heft vii., p. 564) on peucedanin, the author announces that he has been for some time engaged with the investigation of oroselon, a substance extracted from peucedanin.

On Gentianin.—H. Hlasiwetz and J. Habermann.—A preliminary communication. Gentianin (gentisin) is a compound closely related to maclurin, and is easily resolved, by melting caustic potash, into an acid isomeric with protocatechuic acid, $C_7H_6O_4$, phloroglucin, $C_6H_6O_3$, and acetic acid.

No. 9, June 8, 1874.

Crystalline Form and the Molecular Modifications of Selenium.—C. Rammelsberg.—The author finds that sulphur and selenium are isomorphous, and that the parallelism between the two is easily demonstrated. Selenium exhibits four modifications—(1) amorphous, red, soluble; (2) crystalline, red, soluble; (3) granular, grey, insoluble; (4) foliaceous, almost black, insoluble.

Researches on the Constitution of the Nitrol Acids.—V. Meyer and J. Locher.—The authors examine propyl-nitrolic acid, its behaviour with sulphuric acid, the distinctions between propyl-nitrolic and ethyl-nitrolic acids, and the action of nitrous acid upon pseudo-nitro-propan.

Precipitation of Alumina by Borax.—C. Jehn.—The mixture of solutions of borax and alum is generally said to yield a borate of alumina. This is not the case; alumina is precipitated, and the reaction is quantitative.

Researches on the Volume-Constitution of Solid Bodies.—H. Schrœder.—The volumes of the components, and of the respective elements of every compound, are in proportions which may be expressed by simple whole numbers. All volumes can be reduced to a common measure of which they are multiples by whole numbers, if we bear in mind that this common measure varies, within narrow limits, with the crystalline form. For isomorphous bodies of one group it is always constant. Bodies unite only in multiples by whole numbers of equal volumes. All the known corresponding compounds of ammonium and thallium are not merely isomeric, but isosteric (of equal volume). The same rule probably holds good with carbonic acid and nitric acid.

Loss of Nitric Acid in the Manufacture of Sulphuric Acid.—W. Hasenbach.—The loss of nitric acid in the working of the chambers is due to three causes: a portion is retained by the chamber acid; another portion passes into the atmosphere in consequence of imperfect absorption in the Gay-Lussac tower, or faulty conduct of the process; and, lastly, a part is probably reduced to nitrous oxide, or even to free nitrogen. Both in the nitrous tower acid and the chamber acid the nitrogen is present in the state, not of nitrous, but of hyponitric acid. Sulphurous acid reduces the nitric compounds, not merely to nitric oxide, but sometimes to nitrous acid.

History of Chloride of Lime.—C. Schorlemmer.—A controversial notice of Göpner's paper on the same subject.

Communications from the Laboratory of Würzburg University.—J. Wislicenus.—Mixter, Conrad, and Goldberg have been engaged with researches on the derivatives of sodium acetic ether. St. Stephanowitz has prepared hydrargyro-phenyl-xanthogen-amid, $C_{18}H_{20}S_2O_2Hg$, and its silver compound, hydrargyro-phenyl-xanthogen-amid silver nitrate.

New Method of Preparing Durol.—P. Jannasch.—50 grms. of dibrom-dimethyl-benzol, dissolved in benzol, were mixed with iodide of methyl and sodium. The flask was heated in the water-bath. Two distillates were obtained, a liquid and a crystalline, the latter of which had the boiling-point of durol.

Æthyl-Diacetic Acid.—E. Lippmann.—The author maintains that he has anticipated Mixter by six years in the "new" method of preparing this acid, described in No. 7.

Correction.—R. Wagner.—In reference to Professor v. Gorup's paper (*Berichte*, p. 568), the author shows that imperatorin has been analysed by F. Dœbereiner, and its identity with peucedanin has been shown by himself, as appears on reference to Gmelin's "Handbook."

Addition-Product of Bromacetic Acid with Methyl-Sulphide and its Derivatives.—Crum Brown and E. A. Letts.—The object of this paper is to extend the analogy between sulphur and nitrogen, first shown in Oefele's sulphin compounds.

Oxidation of Butyric, Capronic, Succinic, and Oxalic Acids by Nitric Acid.—E. Erlenmeyer, O. Sigel, and L. Belli.—The authors find that normal butyric acid can be converted by nitric acid into succinic acid. Normal capronic acid is oxidised in the same manner to succinic and acetic acids. Succinic and oxalic acids are completely converted into carbonic acid and water, by dilute nitric acid, without the formation of any tangible intermediate products. Acetic acid is scarcely attacked by strong nitric acid, even at elevated temperatures.

Amido-Caprylic and Hydroxyl-Caprylic Acids.—E. Erlenmeyer and O. Sigel.—The former of these acids forms white nacreous leaflets, perfectly neutral to test-paper, which, if cautiously heated, volatilise undecomposed and without previous fusion. They are insoluble in ether, and sparingly soluble in water and alcohol. Hydroxyl-caprylic acid crystallises in small colourless leaflets, fusible at 69·5°, sparingly soluble in water, but readily in alcohol and ether.

Preparation of Methylic Ether.—E. Erlenmeyer and A. Kriechbaumer.—A mixture of 1·3 parts of methylic alcohol and 2 parts of sulphuric ether are heated in a flask fitted with a cohobator. The temperature is gradually raised to 140°, a thermometer being immersed in the liquid. The gas is washed in soda-lye, and conducted into sulphuric acid surrounded by cold water, which absorbs and retains 600 volumes, and from which it can be liberated by the gradual addition of water.

Certain Salts of Boracic Acid.—R. Benedikt.—A valuable paper, but not adapted for abstraction.

Sulpho Compounds of the Three Isomeric Phthalic Acids.—Jos. Schreder.—The author prepares and examines thiophthalic acid, and the sulpho compounds of terephthalic and isophthalic acids.

Correction.—A. Bauer.—A controversial note, referring to Günsberg's paper on the ammonia-soda process (*Berichte*, 272).

On Nitrobutan.—E. Demole.—Nitrobutan, $C_4H_9NO_2$, is a faintly yellow oil, with an odour resembling that of peppermint.—It boils at 137° to 140°. It is dissolved by potash-lye, and re-precipitated by acids, but does not yield a precipitate with alcoholic solution of soda. By the action of iron and acetic acid nitrobutan is converted into butylamin.

Researches on Substitution in Nitrised Fatty Bodies.—V. Meyer and J. Tschermak.—The authors examine dibrom-nitro-ethan, normal and pseudo nitropropan, the bromine substitution products of the nitropropans, the action of bromine upon potassium-pseudo-nitro-propan, and upon the normal compound.

Communications from the Greifswald Laboratory.—H. Limpricht.—Fuming sulphuric acid acting upon paratoluydin forms an ortho- and a meta-sulph acid, along with an acid disulpho compound. The two latter have been examined by Dr. v. Pechmann. The meta-sulph acid, on distillation with hydrate of potassa, yields paratoluydin, but if briskly heated in a capsule para-oxybenzoic acid is formed, with traces of proto-catechuic acid. The diazo compound, formed on treating the meta-sulph acid with nitrous acid, yields, on decomposition with alcohol under pressure, meta-sulpho-toluylic acid, which forms colourless deliquescent crystals. On boiling the diazo compound in water, para-cresol-meta-sulph acid is obtained.

Convenient Preparation of Cuprous Chloride.—K. Heumann.—14·2 parts of powdered oxide of copper are intimately mixed with 7 parts of common zinc powder, and the whole is put very gradually into crude concentrated hydrochloric acid in a beaker with constant stirring. As soon as a white sediment appears more hydrochloric acid is poured in, and the addition of the powder is resumed till the whole quantity is consumed. Finally, if a white powder has been deposited more hydrochloric acid is added, the yellowish brown liquid is allowed to settle for a few moments, and without stirring up the slight precipitate of metallic copper is poured into a flask, which is filled up with boiled water and stoppered. The cuprous chloride soon separates as a snow-white crystalline powder, which is washed with distilled water, and dried in darkness.

Desulphurisation of the Oil of Mustard.—W. Weith.—The author's results on the desulphurisation of the phenyl mustard oil, by means of metallic copper, differ essentially from those of A. W. Hofmann (*Berichte*, vii., page 522).

A New Constituent of Benzoin from Sumatra.—Albert Theegarten.—A preliminary notice. Besides benzoic acid, and Unverdorben's three resins, the author finds in Sumatra benzoin a volatile essential oil, of an odour resembling both that of benzol and of naphthalin. In Siamese samples it was not detected.

Correspondence from St. Petersburg.—A. Kuhlberg.—A. Buttlerow has been engaged with the examination of trimethyl-acetic acid, and the constitution of pinakolin.

Pawlow has prepared dimethyl-isobutyl-carbinol, and obtained from it a new heptylen.

A. Wischnegrodsky has examined dimethyl-ethyl-acetic acid, a new isomer of capronic acid.

Beilstein and Kurbatow, by acting with iodine upon an alcoholic solution of chlor-phenyl-sulphurea,—

$$CS(NC_6H_4ClH)_2,$$

obtain, besides, chloro-phenyl oil of mustard, C_6H_4ClNCS; and trichlor-phenyl-guanidin, $CH_2(C_6H_4Cl)_3N_3$; and sulphur, chlor-aniline, chloro-phenyl-urea, and a sulphur compound which crystallises in needles.

G. Gustavson obtains iodethyliden from chlorethyliden, by adding the latter to a solution of iodide of aluminium in sulphide of carbon.

Tawildarow obtained $C_4H_7BrO_2$ by heating bromacetyl with aldehyd to 130° in a sealed tube.

Mendelejew reports on an improved mercurial air-pump.

Ley and Popoff have studied the oxidation of the secondary oxyacids of the fatty series.

Potilizin gives a preliminary announcement of his researches on the mutual displacement of the haloids in their compounds.

Gagarin has examined the isomeric compounds of the formula C_2H_4BrI.

Goldstein finds that on the cautious oxidation of volatile nitro-phenol by permanganic acid two nitro-phenols are united, and two atoms of hydrogen separated out.

Reimann's Farber Zeitung, No. 23, 1874.

This number contains directions for dyeing leather with aniline colours.

An absurd receipt for dyeing an orange on cotton—but calculated to produce a brown—is copied from a rival technological paper.

There are also receipts for a green on half-wool garments; for bleaching cotton; for an iron buff on cotton pieces; for a grey on wool; a very pale grey, a greenish mode grey, a reddish mode grey, a darker shade of the same, and a light Havanna on cloth; a scarlet on cotton-yarn; an opal blue on cotton-yarn and calico; and a vat blue, topped with logwood, on cotton yarn.

For brightening greys on wool and mixed goods it is recommended to top them with indulin, known otherwise as indigo substitute.

Wool may be dyed with iodine green in the same manner as with Nicholson blue. For 10 lbs. of wool 100 grms. of iodine green, and 500 grms. of borax, are dissolved in water at 40° R. The raising bath should contain 150 grms. of sulphuric acid.

No. 24, 1874.

The editor shows the unprofitable nature of a "fast blue without indigo"—which, further, is not fast—recommended by one of his contemporaries, and advises the use in its stead of a vat blue topped with logwood.

The article on dyeing leather with the coal-tar colours is concluded with the following receipt for glazing:—Dissolve 100 grms. lactarin in 1 litre water at 60° R., with the addition of strong ammonia as required. This glaze is particularly recommended for red shades, aniline, violets, iodine green, &c.

Unger has come forward with a lengthy paper in defence of his former assertion that ultramarine contains nitrogen as an essential constituent.

THE CHEMICAL NEWS.

Vol. XXX. No. 769.

BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

Belfast Meeting, August 19, 1874.

INAUGURAL ADDRESS OF THE PRESIDENT,

John Tyndall, F.R.S., D.C.L. Oxon, LL.D. Cantab., F.C.P.S., Professor of Natural Philosophy in the Royal Institution.

An impulse inherent in primeval man turned his thoughts and questionings betimes towards the sources of natural phenomena. The same impulse, inherited and intensified, is the spur of scientific action to-day. Determined by it, by a process of abstraction from experience we form physical theories which lie beyond the pale of experience, but which satisfy the desire of the mind to see every natural occurrence resting upon a cause. In forming their notions of the origin of things, our earliest historic (and doubtless, we might add, our pre-historic) ancestors pursued, as far as their intelligence permitted, the same course. They also fell back upon experience, but with this difference—that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of Nature, but from what lay much closer to them, the observation of men. Their theories accordingly took an anthropomorphic form. To supersensual beings, which, "however potent and invisible, were nothing but a species of human creatures, perhaps raised from among mankind, and retaining all human passions and appetites,"[*] were handed over the rule and governance of natural phenomena.

Tested by observation and reflection, these early notions failed in the long run to satisfy the more penetrating intellects of our race. Far in the depths of history we find men of exceptional power differentiating themselves from the crowd, rejecting these anthropomorphic notions, and seeking to connect natural phenomena with their physical principles. But long prior to these purer efforts of the understanding the merchant had been abroad, and rendered the philosopher possible; commerce had been developed, wealth amassed, leisure for travel and for speculation secured, while races educated under different conditions—and therefore differently informed and endowed—had been stimulated and sharpened by mutual contact. In those regions where the commercial aristocracy of ancient Greece mingled with its eastern neighbours, the sciences were born, being nurtured and developed by free-thinking and courageous men. The state of things to be displaced may be gathered from a passage of Euripides quoted by Hume:—"There is nothing in the world; no glory, no prosperity. The gods toss all into confusion; mix everything with its reverse, that all of us, from our ignorance and uncertainty, may pay them the more worship and reverence." Now, as science demands the radical extirpation of caprice and the absolute reliance upon law in Nature, there grew with the growth of scientific notions a desire and determination to sweep from the field of theory this mob of gods and demons, and to place natural phenomena on a basis more congruent with themselves.

The problem which had been previously approached from above was now attacked from below; theoretic effort passed from the super- to the sub-sensible. It was felt that to construct the universe in idea it was necessary to have some notion of its constituent parts—of what Lucretius subsequently called the "First Beginnings." Abstracting again from experience, the leaders of scientific speculation reached at length the pregnant doctrine of atoms and molecules, the latest developments of which were set forth with such power and clearness at the last meeting of the British Association. Thought no doubt had long hovered about this doctrine before it attained the precision and completeness which it assumed in the mind of Democritus,[*] a philosopher who may well for a moment arrest our attention. "Few great men," says Lange, in his excellent "History of Materialism," a work to the spirit and the letter of which I am equally indebted, "have been so despitefully used by history as Democritus. In the distorted images sent down to us through unscientific traditions there remains of him almost nothing but the name of 'the laughing philosopher,' while figures of immeasurably smaller significance spread themselves at full length before us." Lange speaks of Bacon's high appreciation of Democritus—for ample illustrations of which I am indebted to my excellent friend Mr. Spedding, the learned editor and biographer of Bacon. It is evident, indeed, that Bacon considered Democritus to be a man of weightier metal than either Plato or Aristotle, though their philosophy "was noised and celebrated in the schools, amid the din and pomp of professors." It was not they, but Genseric and Attila and the barbarians, who destroyed the atomic philosophy. "For at a time when all human learning had suffered shipwreck, these planks of Aristotelian and Platonic philosophy, as being of a lighter and more inflated substance, were preserved and came down to us, while things more solid sank and almost passed into oblivion."

The principles enunciated by Democritus reveal his uncompromising antagonism to those who deduced the phenomena of nature from the caprices of the gods. They are briefly these:—1. From nothing comes nothing. Nothing that exists can be destroyed. All changes are due to the combination and separation of molecules. 2. Nothing happens by chance. Every occurrence has its cause from which it follows by necessity. 3. The only existing things are the atoms and empty space; all else is mere opinion. 4. The atoms are infinite in number, and infinitely various in form; they strike together, and the lateral motions and whirlings which thus arise are the beginnings of worlds. 5. The varieties of all things depend upon the varieties of their atoms, in number, size, and aggregation. 6. The soul consists of free, smooth, round atoms, like those of fire. These are the most mobile of all. They interpenetrate the whole body, and in their motions the phenomena of life arise. Thus the atoms of Democritus are individually without sensation; they combine in obedience to mechanical laws; and not only organic forms, but the phenomena of sensation and thought are also the result of their combination.

That great enigma, "the exquisite adaptation of one part of an organism to another part, and to the conditions of life," more especially the construction of the human body, Democritus made no attempt to solve. Empedocles a man of more fiery and poetic nature, introduced the notion of love and hate among the atoms to account for their combination and separation. Noticing this gap in the doctrine of Democritus, he struck in with the penetrating thought—linked, however, with some wild speculation—that it lay in the very nature of those combinations which were suited to their ends (in other words, in harmony with their environment) to maintain themselves while unfit combinations, having no proper habitat, must rapidly disappear. Thus more than 2000 years ago the doctrine of the "survival of the fittest," which in our day —not on the basis of vague conjecture, but of positive knowledge—has been raised to such extraordinary significance, had received at all events partial enunciation.[†]

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[*] Hume, "Natural History of Religion."

[*] Born 460 B.C.

[†] Lange, 2nd edit., p. 23.

Epicurus,[*] said to be the son of a poor schoolmaster at Samos, is the next dominant figure in the history of the atomic philosophy. He mastered the writings of Democritus, heard lectures in Athens, returned to Samos, and subsequently wandered through various countries. He finally returned to Athens, where he bought a garden, and surrounded himself by pupils, in the midst of whom he lived a pure and serene life, and died a peaceful death. His philosophy was almost identical with that of Democritus, but he never quoted either friend or foe. One main object of Epicurus was to free the world from superstition and the fear of death. Death he treated with indifference. It merely robs us of sensation. As long as we are, death is not; and when death is, we are not. Life has no more evil for him who has made up his mind that it is no evil not to live. He adored the gods, but not in the ordinary fashion. The idea of divine power, properly purified, he thought an elevating one. Still he taught—"Not he is godless who rejects the gods of the crowd, but rather he who accepts them." The gods were to him eternal and immortal beings, whose blessedness excluded every thought of care or occupation of any kind. Nature pursues her course in accordance with everlasting laws, the gods never interfering. They haunt—

> "The lucid interspace of world and world
> Where never creeps a cloud or moves a wind,
> Nor ever falls the least white star of snow,
> Nor ever lowest roll of thunder moans,
> Nor sound of human sorrow mounts to mar
> Their sacred everlasting calm."[†]

Lange considers the relation of Epicurus to the gods subjective; the indication, probably, of an ethical requirement of his own nature. We cannot read history with open eyes, or study human nature to its depths, and fail to discern such a requirement. Man never has been, and he never will be, satisfied with the operations and products of the Understanding alone; hence physical science cannot cover all the demands of his nature. But the history of the efforts made to satisfy these demands might be broadly described as a history of errors—the error consisting in ascribing fixity to that which is fluent, which varies as we vary, being gross when we are gross, and becoming, as our capacities widen, more abstract and sublime. On one great point the mind of Epicurus was at peace. He neither sought nor expected, here or hereafter, any personal profit from his relation to the gods. And it is assuredly a fact that loftiness and serenity of thought may be promoted by conceptions which involve no idea of profit of this kind. "Did I not believe," said a great man to me once, "that an Intelligence is at the heart of things, my life on earth would be intolerable." The utterer of these words is not, in my opinion, rendered less noble, but more noble, by the fact that it was the need of ethical harmony here, and not the thought of personal profit hereafter, that prompted his observation.

A century and a half after the death of Epicurus, Lucretius[‡] wrote his great poem, "On the Nature of Things," in which he, a Roman, developed with extraordinary ardour the philosophy of his Greek predecessor. He wishes to win over his friend Memnius to the school of Epicurus; and although he has no rewards in a future life to offer, although his object appears to be a purely negative one, he addresses his friend with the heat of an apostle. His object, like that of his great forerunner, is the destruction of superstition; and considering that men trembled before every natural event as a direct monition from the gods, and that everlasting torture was also in prospect, the freedom aimed at by Lucretius might perhaps be deemed a positive good. "This terror," he says, "and darkness of mind must be dispelled, not by the rays of the sun and glittering shafts of day, but by the aspect and the law of Nature." He refutes the notion that anything can come out of nothing, or that which is once begotten can be recalled to nothing. The first beginnings, the atoms, are indestructible, and into them all things can be dissolved at last. Bodies are partly atoms, and partly combinations of atoms; but the atoms nothing can quench. They are strong in solid singleness, and by their denser combination all things can be closely packed and exhibit enduring strength. He denies that matter is infinitely divisible. We come at length to the atoms, without which, as an imperishable substratum, all order in the generation and development of things would be destroyed.

The mechanical shock of the atoms being in his view the all-sufficient cause of things, he combats the notion that the constitution of Nature has been in any way determined by intelligent design. The interaction of the atoms throughout infinite time rendered all manner of combinations possible. Of these the fit ones persisted, while the unfit ones disappeared. Not after sage deliberation did the atoms station themselves in their right places, nor did they bargain what motions they should assume. From all eternity they have been driven together, and, after trying motions and unions of every kind, they fell at length into the arrangements out of which this system of things has been formed. His grand conception of the atoms falling silently through immeasurable ranges of space and time suggested the nebular hypothesis to Kant, its first propounder,—"If you will apprehend and keep in mind these things, Nature, free at once, and rid of her haughty lords, is seen to do all things spontaneously of herself, without the meddling of the gods."[*]

During the centuries between the first of these three philosophers and the last, the human intellect was active in other fields than theirs. The sophists had run through their career. At Athens had appeared the three men—Socrates, Plato, and Aristotle—whose yoke remains to some extent unbroken to the present hour. Within this period, also, the School of Alexandria was founded, Euclid wrote his "Elements," and he and others made some advance in optics. Archimedes had propounded the theory of the lever, and the principles of hydrostatics. Pythagoras had made his experiments on the harmonic intervals, while astronomy was immensely enriched by the discoveries of Hipparchus, who was followed by the historically more celebrated Ptolemy. Anatomy had been made the basis of Scientific medicine, and it is said by Draper[†] that vivisection then began. In fact the Science of ancient Greece had already cleared the world of the fantastic images of divinities operating capriciously through natural phenomena. It had shaken itself free from that fruitless scrutiny "by the internal light of the mind alone," which had vainly sought to transcend experience and reach a knowledge of ultimate causes. Instead of accidental observation, it had introduced observation with a purpose; instruments were employed to aid the senses; and scientific method was rendered in a great measure complete by the union of Induction and Experiment.

What, then, stopped its victorious advance? Why was the scientific intellect compelled, like an exhausted soil, to lie fallow for nearly two millenniums before it could regather the elements necessary to its fertility and strength? Bacon has already let us know one cause; Whewell ascribes this stationary period to four causes—obscurity of thought, servility, intolerance of disposition, enthusiasm of temper; and he gives striking examples of each.[‡] But these characteristics must have had their causes, which lay in the circumstances of the time. Rome, and the other cities of the Empire, had fallen into moral putrefaction. Christianity had appeared, offering the Gospel to the poor, and, by moderation if not asceticism of life, practically protesting against the profligacy of the age.

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[*] Born 342 B.C.

[†] Tennyson's "Lucretius."

[‡] Born 99 B.C.

[*] Monro's translation. In his criticism of this work ("Contemporary Review," 1867) Dr. Hayman does not appear to be aware of the really sound and subtile observations on which the reasoning of Lucretius, though erroneous, sometimes rests.

[†] "History of the Intellectual Development of Europe," p. 295.

[‡] "History of the Inductive Sciences," vol. i.

The sufferings of the early Christians and the extraordinary exaltation of mind which enabled them to triumph over the diabolical tortures to which they were subjected,* must have left traces not easily effaced. They scorned the earth, in view of that "building of God, that house not made with hands, eternal in the heavens." The Scriptures which ministered to their spiritual needs were also the measure of their Science. When, for example, the celebrated question of antipodes came to be discussed, the Bible was with many the ultimate court of appeal. Augustine, who flourished A.D. 400, would not deny the rotundity of the earth; but he would deny the possible existence of inhabitants at the other side, "because no such race is recorded in Scripture among the descendants of Adam." Archbishop Boniface was shocked at the assumption of a "world of human beings out of the reach of the means of salvation." Thus reined in, Science was not likely to make much progress. Later on the political and theological strife between the Church and civil governments, so powerfully depicted by Draper, must have done much to stifle investigation.

Whewell makes many wise and brave remarks regarding the spirit of the Middle Ages. It was a menial spirit. The seekers after natural knowledge had forsaken that fountain of living waters, the direct appeal to Nature by observation and experiment, and had given themselves up to the re-manipulation of the notions of their predecessors. It was a time when thought had become abject, and when the acceptance of mere authority led, as it always does in science, to intellectual death. Natural events, instead of being traced to physical, were referred to moral causes; while an exercise of the phantasy, almost as degrading as the spiritualism of the present day, took the place of scientific speculation. Then came the mysticism of the Middle Ages, magic, alchemy, the neo-platonic philosophy, with its visionary though sublime abstractions, which caused men to look with shame upon their own bodies as hindrances to the absorption of the creature in the blessedness of the Creator. Finally came the Scholastic philosophy, a fusion, according to Lange, of the least-mature notions of Aristotle with the Christianity of the west. Intellectual immobility was the result. As a traveller without a compass in a fog may wander long, imagining he is making way, and finding himself after hours of toil at his starting-point, so the schoolmen, having tied and untied the same knots, and formed and dissipated the same clouds, found themselves at the end of centuries in their old position.

With regard to the influence wielded by Aristotle in the Middle Ages, and which, though to a less extent, he still wields, I would ask permission to make one remark. When the human mind has achieved greatness and given evidence of extraordinary power in any domain, there is a tendency to credit it with similar power in all other domains. Thus theologians have found comfort and assurance in the thought that Newton dealt with the question of revelation, forgetful of the fact that the very devotion of his powers, through all the best years of his life, to a totally different class of ideas, not to speak of any natural disqualification, tended to render him less instead of more competent to deal with theological and historic questions. Goethe, starting from his established greatness as a poet, and indeed from his positive discoveries in natural history, produced a profound impression among the painters of Germany when he published his "Farbenlehre," in which he endeavoured to overthrow Newton's theory of colours. This theory he deemed so obviously absurd, that he considered its author a charlatan, and attacked him with a corresponding vehemence of language. In the domain of natural history Goethe had made really considerable discoveries; and we have high authority for assuming that, had he devoted himself wholly to that side of science, he might have reached in it an eminence comparable with that which he attained as a poet. In sharpness of observation, in the detection of analogies however apparently remote, in the classification and organisation of facts according to the analogies discerned, Goethe possessed extraordinary powers. These elements of scientific inquiry fall in with the discipline of the poet. But, on the other hand, a mind thus richly endowed in the direction of natural history may be almost shorn of endowment as regards the more strictly called physical and mechanical sciences. Goethe was in this condition. He could not formulate distinct mechanical conceptions: he could not see the force of mechanical reasoning; and in regions where such reasoning reigns supreme he became a mere *ignis fatuus* to those who followed him.

I have sometimes permitted myself to compare Aristotle with Goethe, to credit the Stagirite with an almost superhuman power of amassing and systematising facts, but to consider him fatally defective on that side of the mind in respect to which incompleteness has been just ascribed to Goethe. Whewell refers the errors of Aristotle, not to a neglect of facts, but to "a neglect of the idea appropriate to the facts; the idea of Mechanical cause, which is Force, and the substitution of vague or inapplicable notions, involving only relations of space or emotions of wonder." This is doubtless true; but the word "neglect" implies mere intellectual misdirection; whereas in Aristotle, as in Goethe, it was not, I believe, misdirection, but sheer natural incapacity which lay at the root of his mistakes. As a physicist, Aristotle displayed what we should consider some of the worst attributes of a modern physical investigator—indistinctness of ideas, confusion of mind, and a confident use of language, which led to the delusive notion that he had really mastered his subject, while he as yet had failed to grasp even the elements of it. He put words in the place of things, subject in the place of object. He preached induction without practising it, inverting the true order of inquiry by passing from the general to the particular, instead of from the particular to the general. He made of the universe a closed sphere, in the centre of which he fixed the earth, proving from general principles, to his own satisfaction and to that of the world for near 2000 years, that no other universe was possible. His notions of motion were entirely unphysical. It was natural or unnatural, better or worse, calm or violent—no real mechanical conception regarding it lying at the bottom of his mind. He affirmed that a vacuum could not exist, and proved that if it did exist motion in it would be impossible. He determined *a priori* how many species of animals must exist, and shows on general principles why animals must have such and such parts. When an eminent contemporary philosopher, who is far removed from errors of this kind, remembers these abuses of the *a priori* method, he will be able to make allowance for the jealousy of physicists as to the acceptance of so-called *a priori* truths. Aristotle's errors of detail were grave and numerous. He affirmed that only in man we had the beating of the heart, that the left side of the body was colder that the right, that men have more teeth than women, and that there is an empty space, not at the front, but at the back of every man's head.

There is one essential quality in physical conceptions which was entirely wanting in those of Aristotle and his followers. I wish it could be expressed by a word untainted by its associations; it signifies a capability of being placed as a coherent picture before the mind. The Germans express the act of picturing by the word *vorstellen*, and the picture they call a *Vorstellung*. We have no word in English which comes nearer to our requirements than *Imagination*, and, taken with its proper limitations, the word answers very well; but, as just intimated, it is tainted by its associations, and therefore objectionable to some minds. Compare, with reference to this capacity of mental presentation, the case of the Aristotelian, who refers the ascent of water in a pump to Nature's abhorrence of a vacuum, with that of Pascal when he proposed to solve the question of atmospheric pressure by the ascent of the Puy de Dome. In the one case, the terms of the explanation refuse to fall into place as a physical image; in the other the image is distinct, the fall and rise of the barometer being clearly figured as the balancing of two varying and opposing pressures.

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* Depicted with terrible vividness in Renan's "Antichrist."

During the drought of the Middle Ages in Christendom, the Arabian intellect, as forcibly shown by Draper, was active. With the intrusion of the Moors into Spain, cleanliness, order, learning, and refinement took the place of their opposites. When smitten with disease the Christian peasant resorted to a shrine, the Moorish one to an instructed physician. The Arabs encouraged translations from the Greek philosophers, but not from the Greek poets. They turned in disgust "from the lewdness of our classical mythology, and denounced as an unpardonable blasphemy all connection between the impure Olympian Jove and the Most High God." Draper traces still further than Whewell the Arab elements in our scientific terms, and points out that the under garment of ladies retains to this hour its Arab name. He gives examples of what Arabian men of science accomplished, dwelling particularly on Alhazen, who was the first to correct the Platonic notion that rays of light are emitted by the eye. He discovered atmospheric refraction, and points out that we see the sun and moon after they have set. He explains the enlargement of the sun and moon, and the shortening of the vertical diameters of both these bodies when near the horizon. He is aware that the atmosphere decreases in density with increase of height, and actually fixes its height at 58½ miles. In the Book of the Balance Wisdom, he sets forth the connection between the weight of the atmosphere and its increasing density. He shows that a body will weigh differently in a rare and a dense atmosphere: he considers the force with which plunged bodies rise through heavier media. He understands the doctrine of the centre of gravity, and applies it to the investigation of balances and steelyards. He recognises gravity as a force, though he falls into the error of making it diminish as the distance, and of making it purely terrestrial. He knows the relation between the velocities, spaces, and times of falling bodies, and has distinct ideas of capillary attraction. He improves the hydrometer. The determination of the densities of bodies as given by Alhazen approach very closely to our own. "I join," says Draper, in the pious prayer of Alhazen, "that in the day of judgment the All-Merciful will take pity on the soul of Abur-Raihân, because he was the first of the race of men to construct a table of specific gravities." If all this be historic truth (and I have entire confidence in Dr. Draper), well may he "deplore the systematic manner in which the literature of Europe has contrived to put out of sight our scientific obligations to the Mahommedans."[*]

Towards the close of the stationary period a word-weariness, if I may so express it, took more and more possession of men's minds. Christendom had become sick of the School philosophy and its verbal wastes, which led to no issue, but left the intellect in everlasting haze. Here and there was heard the voice of one impatiently crying in the wilderness, "Not unto Aristotle, not unto subtle hypotheses, not unto church, bible, or blind tradition, must we turn for a knowledge of the universe, but to the direct investigation of nature by observation and experiment." In 1543 the epoch-making work of Copernicus on the paths of the heavenly bodies appeared. The total crash of Aristotle's closed universe with the earth at its centre followed as a consequence; and "the earth moves" became a kind of watchword among intellectual freemen. Copernicus was Canon of the church of Frauenburg in the diocese of Ermeland. For three-and-thirty years he had withdrawn himself from the world, and devoted himself to the consolidation of his great scheme of the solar system. He made its blocks eternal; and even to those who feared it and desired its overthow it was so obviously strong that they refrained for a time from meddling with it. In the last year of the life of Copernicus his book appeared: it is said that the old man received a copy of it a few days before his death, and then departed in peace.

The Italian philosopher Giordano Bruno was one of the earliest converts to the new astronomy. Taking Lucretius as his exemplar, he revived the notion of the infinity of worlds; and, combining with it the doctrine of Copernicus, reached the sublime generalisation that the fixed stars are suns, scattered numberless through space and accompanied by satellites, which bear the same relation to them that our earth does to our sun, or our moon to our earth. This was an expansion of transcendent import; but Bruno came closer than this to our present line of thought. Struck with the problem of the generation and maintenance of organisms, and duly pondering it, he came to the conclusion that Nature in her productions does not imitate the technic of man. Her process is one of unravelling and unfolding. The infinity of forms under which matter appears were not imposed upon it by an external artificer; by its own intrinsic force and virtue it brings these forms forth. Matter is not the mere naked empty *capacity* which philosophers have pictured her to be, but the universal mother, who brings forth all things as the fruit of her own womb.

This outspoken man was originally a Dominican monk. He was accused of heresy, and had to fly, seeking refuge in Geneva, Paris, England, and Germany. In 1592 he fell into the hands of the Inquisition at Venice. He was imprisoned for many years, tried, degraded, excommunicated, and handed over to the civil power, with the request that he should be treated gently, and "without the shedding of blood." This meant that he was to be burnt; and burnt accordingly he was, on the 16th of February, 1600. To escape a similar fate Galileo, thirty-three years afterwards, abjured, upon his knees, and with his hand upon the holy gospels, the heliocentric doctrine. After Galileo came Kepler, who from his German home defied the power beyond the Alps. He traced out from pre-existing observations the laws of planetary motion. The problem was thus prepared for Newton, who bound those empirical laws together by the principle of gravitation.

During the Middle Ages the doctrine of atoms had to all appearance vanished from discussion. In all probability it held its ground among sober-minded and thoughtful men, though neither the church nor the world was prepared to hear of it with tolerance. Once, in the year 1348, it received distinct expression. But retractation by compulsion immediately followed, and, thus discouraged, it slumbered till the 17th century, when it was revived by a contemporary of Hobbes and Descartes, the Père Gassendi.

The analytic and synthetic tendencies of the human mind exhibit themselves throughout history, great writers ranging themselves sometimes on the one side, sometimes on the other. Men of lofty feelings, and minds open to the elevating impressions produced by Nature as a whole, whose satisfaction, therefore, is rather ethical than logical, have leaned to the synthetic side; while the analytic harmonises best with the more precise and more mechanical bias which seeks the satisfaction of the understanding. Some form of Pantheism was usually adopted by the one, while a detached Creator, working more or less after the manner of men, was often assumed by the other.[*] Gassendi is hardly to be ranked with either. Having formally acknowledged God as the great first cause, he immediately drops the idea, applies the known laws of mechanics to the atoms, and thence deduces all vital phenomena. God who created earth and water, plants and animals, produced in the first place a definite number of atoms, which constituted the seed of all things. Then began that series of combinations and decompositions which goes on at the present day, and which will continue in the future. The principle of every change resides in matter. In artificial productions the moving principle is different from the material worked upon; but in Nature the agent works within, being the most active and mobile part of the material itself. Thus this bold ecclesiastic, without incurring the censure of the church or the world, contrives to outstrip Mr. Darwin. The same cast of mind which caused him to detach the Creator from his universe led him also to detach the soul from the body, though to the body he ascribes an influence so large as to render the soul almost unnecessary. The aberrations of reason were in his view an affair of the material brain. Mental disease is brain disease; but then the immortal reason sits apart, and cannot be touched by the disease. The errors of madness are errors of the instrument, not of the performer.

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[*] "Intellectual Development of Europe," p. 359.

[*] Boyle's model of the universe was the Strasburg clock with an outside Artificer. Goethe, on the other hand, sang

"Ihm ziemt's die Welt im Innern zu bewegen,
Natur in sich, sich in Natur zu hegen."

The same repugnance to the Clockmaker conception is manifest in Carlyle.

It may be more than a mere result of education, connecting itself probably with the deeper mental structure of the two men, that the idea of Gassendi, above enunciated, is substantially the same as that expressed by Professor Clerk Maxwell at the close of the very noble lecture delivered by him at Bradford last year. According to both philosophers, the atoms, if I understand aright, are the *prepared materials*, the "manufactured articles," which, formed by the skill of the Highest, produce by their subsequent inter-action all the phenomena of the material world. There seems to be this difference, however, between Gassendi and Maxwell. The one *postulates*, the other *infers*, his first cause. In his manufactured articles, Professor Maxwell finds the basis of an induction, which enables him to scale philosophic heights considered inaccessible by Kant, and to take the logical step from the atoms to their Maker.

The atomic doctrine, in whole or in part, was entertained by Bacon, Descartes, Hobbes, Locke, Newton, Boyle, and their successors, until the chemical law of multiple proportions enabled Dalton to confer upon it an entirely new significance. In our day there are secessions from the theory, but it still stands firm. Only a year or two ago Sir William Thomson, with characteristic penetration, sought to determine the sizes of the atoms, or rather to fix the limits between which their sizes lie; while only last year the discourses of Williamson and Maxwell illustrate the present hold of the doctrine upon the foremost scientific minds. What these atoms, self-moved and self-posited, can and cannot accomplish in relation to life, is at the present moment the subject of profound scientific thought. I doubt the legitimacy of Maxwell's logic; but it is impossible not to feel the ethic glow with which his lecture concludes. There is, moreover, a Lucretian grandeur in his description of the steadfastness of the atoms:—"Natural causes, as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But, though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules out of which these systems are built, the foundation stones of the material universe, remain unbroken and unworn."

Ninety years subject to Gassendi, the doctrine of bodily instruments, as it may be called, assumed immense importance in the hands of Bishop Butler, who, in his famous "Analogy of Religion," developed, from his own point of view, and with consummate sagacity, a similar idea. The Bishop still influences superior minds; and it will repay us to dwell for a moment on his views. He draws the sharpest distinction between our real selves and our bodily instruments. He does not, as far as I remember, use the word soul, possibly because the term was so hackneyed in his day as it had been for many generations previously. But he speaks of "living powers," "perceiving" or "percipient powers," "moving agents," "ourselves," in the same sense as we should employ the term soul. He dwells upon the fact that limbs may be removed, and mortal diseases assail the body, while the mind, almost up to the moment of death, remains clear. He refers to sleep and to swoon, where the "living powers" are suspended but not destroyed. He considers it quite as easy to conceive of an existence out of our bodies as in them; that we may animate a succession of bodies, the dissolution of all of them having no more tendency to dissolve our real selves, or "deprive us of living faculties—the faculties of perception and action—than the dissolution of any foreign matter which we are capable of receiving impressions from, or making use of for the common occasions of life." This is the key of the Bishop's position: "our organised bodies are no more a part of ourselves than any other matter around us." In proof of this he calls attention to the use of glasses, which "prepare objects" for the "percipient power" exactly as the eye does. The eye itself is no more percipient than the glass, and is quite as much the instrument of the true self, and also as foreign to the true self, as the glass is. "And if we see with our eyes only in the same manner as we do with glasses, the like may justly be concluded from analogy of all our senses."

Lucretius, as you are aware, reached a precisely opposite conclusion; and it certainly would be interesting, if not profitable, to us all, to hear what he would or could urge in opposition to the reasoning of the Bishop. As a brief discussion of the point will enable us to see the bearings of an important question, I will here permit a disciple of Lucretius to try the strength of the Bishop's position, and then allow the Bishop to retaliate, with the view of rolling back, if he can, the difficulty upon Lucretius. Each shall state his case fully and frankly; and you shall be umpire between them.

The argument might proceed in this fashion:—

"Subjected to the test of mental presentation (*Vorstellung*), your views, most honoured prelate, would present to many minds a great, if not an insuperable, difficulty. You speak of 'living powers,' 'percipient or perceiving powers,' and 'ourselves;' but can you form a mental picture of any one of these apart from the organism through which it is supposed to act? Test yourself honestly, and see whether you possess any faculty that would enable you to form such a conception. The true self has a local habitation in each of us; thus localised, must it not possess a form? If so, what form? Have you ever for a moment realised it? When a leg is amputated, the body is divided into two parts; is the true self in both of them or in one? Thomas Aquinas might say in both; but not you, for you appeal to the consciousness associated with one of the two parts to prove that the other is foreign matter. Is consciousness, then, a necessary element of the true self? If so, what do you say to the case of the whole body being deprived of consciousness? If not, then on what grounds do you deny any portion of the true self to the severed limb? It seems very singular that, from the beginning to the end of your admirable book (and no one admires its sober strength more than I do), you never once mention the brain or nervous system. You begin at one end of the body, and show that its parts may be removed without prejudice to the perceiving power. What if you begin at the other end, and remove, instead of the leg, the brain? The body, as before, is divided into two parts; but both are now in the same predicament, and neither can be appealed to to prove that the other is foreign matter. Or, instead of going so far as to remove the brain itself, let a certain portion of its bony covering be removed, and let a rhythmic series of pressures and relaxations of pressure be applied to the soft substance. At every pressure 'the faculties of perception and of action' vanish; at every relaxation of pressure they are restored. Where, during the intervals of pressure, is the perceiving power? I once had the discharge of a large Leyden battery passed unexpectedly through me: I felt nothing, but was simply blotted out of conscious existence for a sensible interval. Where was my true self during that interval? Men who have recovered from lightning-stroke have been much longer in the same state; and indeed, in cases of ordinary concussion of the brain, days may elapse during which no experience is registered in consciousness. Where is the man himself during the period of insensibility? You may say that I beg the question when I assume the man to have been unconscious, that he was really conscious all the time, and has simply forgotten what had occurred to him. In reply to this, I can only say that no one need shrink from the worst tortures that superstition ever invented if only so felt and so remembered. I do not think your theory of instruments goes at all to the bottom of the matter. A telegraph operator has his instruments, by means of which he converses with the world; our bodies possess a nervous system, which plays a similar part between the perceiving power and external things. Cut the wires of the operator, break his battery, demagnetise his needle: by this means you certainly sever his connection with the world; but, inasmuch as these are real instruments, their destruction does not touch the man who uses them. The operator survives, *and he knows that he survives*. What is it, I would ask, in the human system that answers to this conscious survival of the operator when the battery of the brain is so disturbed as to produce insensibility, or when it is destroyed altogether?

"Another consideration, which you may consider slight, presses upon me with some force. The brain may change from health to disease, and through such a change the most exemplary man may be converted into a debauchee or a murderer. My very noble and approved good master had, as you know, threatenings of lewdness introduced into his brain by his jealous wife's philter; and sooner than permit himself to run even the risk of yielding to these base promptings he slew himself. How could the hand of Lucretius have been thus turned against himself if the real Lucretius remained as before? Can the brain or can it not act in this distempered way without the intervention of the immortal reason? If it can, then it is a prime mover which requires only healthy regulation to render it reasonably self-acting, and there is no apparent need of your immortal reason at all. If it cannot, then the immortal reason, by its mischievous activity in operating upon a broken instrument, must have the credit of committing every imaginable extravagance and crime. I think, if you will allow me to say so, that the gravest consequences are likely to flow from your estimate of the body. To regard the brain as you would a staff or an eye-glass—to shut your eyes to all its mystery, to the perfect correlation that reigns between its condition and our consciousness, to the fact that a slight excess or defect of blood in it produces that very swoon to which you refer, and that in relation to it our meat and drink and air and exercise have a perfectly transcendental value and significance—to forget all this does, I think, open a way to innumerable errors in our habits of life, and may possibly in some cases initiate and foster that very disease, and consequent mental ruin, which a wiser appreciation of this mysterious organ would have avoided."

I can imagine the Bishop thoughtful after hearing this argument. He was not the man to allow anger to mingle with the consideration of a point of this kind. After due consideration, and having strengthened himself by that honest contemplation of the facts which was habitual with him, and which includes the desire to give even adverse facts their due weight, I can suppose the Bishop to proceed thus:—"You will remember that in the 'Analogy of Religion,' of which you have so kindly spoken, I did not profess to prove anything absolutely, and that I over and over again acknowledged and insisted on the smallness of our knowledge, or rather the depth of our ignorance, as regards the whole system of the universe. My object was to show my deistical friends, who set forth so eloquently the beauty and beneficence of Nature and the Ruler thereof, while they had nothing but scorn for the so-called absurdities of the Christian scheme, that they were in no better condition than we were, and that, for every difficulty they found upon our side, quite as great a difficulty was to be found upon theirs. I will now, with your permission, adopt a similar line of argument. You are a Lucretian, and from the combination and separation of atoms deduce all terrestrial things, including organic forms and their phenomena. Let me tell you in the first instance how far I am prepared to go with you. I admit that you can build crystalline forms out of this play of molecular force; that the diamond, amethyst, and snow-star are truly wonderful structures which are thus produced. I will go further, and acknowledge that even a tree or flower might in this way be organised. Nay, if you can show me an animal without sensation, I will concede to you that it also might be put together by the suitable play of molecular force.

"Thus far our way is clear, but now comes my difficulty. Your atoms are individually without sensation, much more are they without intelligence. May I ask you, then, to try your hand upon this problem. Take your dead hydrogen atoms, your dead oxygen atoms, your dead carbon atoms, your dead nitrogen atoms, your dead phosphorus atoms, and all the other atoms, dead as grains of shot, of which the brain is formed. Imagine them separate and sensationless; observe them running together and forming all imaginable combinations. This, as a purely mechanical process, is *seeable* by the mind. But can you see, or dream, or in any way imagine, how out of that mechanical act, and from these individually dead atoms, sensation, thought, and emotion are to arise? You speak of the difficulty of mental presentation in my case; is it less in yours? I am not all bereft of this *Vorstellungs-Kraft* of which you speak. I can follow a particle of musk until it reaches the olfactory nerve; I can follow the waves of sound until their tremors reach the water of the labyrinth, and set the otoliths and Corti's fibres in motion; I can also visualise the waves of ether as they cross the eye and hit the retina. Nay more, I am able to follow up to the central organ the motion thus imparted at the periphery, and to see in idea the very molecules of the brain thrown into tremors. My insight is not baffled by these physical processes. What baffles me, what I find unimaginable, transcending every faculty I possess—transcending, I humbly submit, every faculty *you* possess—is the notion that out of those physical tremors you can extract things so utterly incongruous with them as sensation, thought, and emotion. You may say, or think, that this issue of consciousness from the clash of atoms is not more incongruous than the flash of light from the union of oxygen and hydrogen. But I beg to say that it is. For such incongruity as the flash possesses is that which I now force upon your attention. The flash is an affair of consciousness, the objective counterpart of which is a vibration. It is a flash only by your interpretation. *You* are the cause of the apparent incongruity; and *you* are the thing that puzzles me. I need not remind you that the great Leibnitz felt the difficulty which I feel, and that to get rid of this monstrous deduction of life from death he displaced your atoms by his monads, which were more or less perfect mirrors of the universe, and out of the summation and integration of which he supposed all the phenomena of life—sentient, intellectual, and emotional—to arise.

"Your difficulty, then, as I see you are ready to admit, is quite as great as mine. You cannot satisfy the human understanding in its demand for logical continuity between molecular processes and the phenomena of consciousness. This is a rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life. What is the moral, my Lucretian? You and I are not likely to indulge in ill-temper in the discussion of these great topics, where we see so much room for honest differences of opinion. But there are people of less wit or more bigotry (I say it with humility) on both sides, who are ever ready to mingle anger and vituperation with such discussions. There are, for example, writers of note and influence at the present day who are not ashamed to assume the 'deep personal sin' of a great logician to be the cause of his unbelief in a theologic dogma. And there are others who hold that we, who cherish our noble Bible, wrought as it has been into the constitution of our forefathers, and by inheritance into us, must necessarily be hypocritical and insincere. Let us disavow and discountenance such people, cherishing the unswerving faith that what is good and true in both our arguments will be preserved for the benefit of humanity, while all that is bad or false will disappear."

It is worth remarking that in one respect the Bishop was a product of his age. Long previous to his day the nature of the soul had been so favourite and general a topic of discussion that, when the students of the University of Paris wished to know the leanings of a new Professor, they at once requested him to lecture upon the soul. About the time of Bishop Butler the question was not only agitated but extended. It was seen by the clear-witted men who entered this arena that many of their best arguments applied equally to brutes and men. The Bishop's arguments were of this character. He saw it, admitted it, accepted the consequences, and boldly embraced the whole animal world in his scheme of immortality.

Bishop Butler accepted with unwavering trust the chronology of the Old Testament, describing it as "confirmed by the natural and civil history of the world, collected from common historians, from the state of the earth, and from the late inventions of arts and sciences." These words mark progress: they must seem somewhat hoary to the Bishop's successors of to-day.[*] It is hardly necessary to inform you that since his time the domain of the naturalist has been immensely extended—the whole science of geology, with its astounding revelations regarding the life of the ancient earth, having been created. The rigidity of old conceptions has been relaxed, the public mind being rendered gradually tolerant of the idea that not for six thousand, nor for sixty thousand, nor for six thousand thousand, but for æons embracing untold millions of years, this earth has been the theatre of life and death. The riddle of the rocks has been read by the geologist and palæontologist, from subcambrian depths to the deposits thickening over the sea-bottoms of to-day. And upon the leaves of that stone book are, as you know, stamped the characters, plainer and surer than those formed by the ink of history, which carry the mind back into abysses of past time compared with which the periods which satisfied Bishop Butler cease to have a visual angle. Everybody now knows this; all men admit it; still when they were first broached these verities of science found loud-tongued denunciators, who proclaimed not only their baselessness considered scientifically, but their immorality considered as questions of ethics and religion: the Book of Genesis had stated the question in a different fashion; and science must necessarily go to pieces when it clashed with this authority. And as the seed of the thistle produces a thistle, and nothing else, so these objectors scatter their germs abroad, and reproduce their kind, ready to play again the part of their intellectual progenitors, to show the same virulence, the same ignorance, to achieve for a time the same success, and finally to suffer the same inexorable defeat. Surely the time must come at last when human nature in its entirety, whose legitimate demands it is admitted science alone cannot satisfy, will find interpreters and expositors of a different stamp from those rash and ill-informed persons who have been hitherto so ready to hurl themselves against every new scientific revelation, lest it should endanger what they are pleased to consider theirs.

The lode of discovery once struck, those petrified forms in which life was at one time active increased to multitudes and demanded classification. The general fact soon became evident that none but the simplest forms of life lie lowest down, that as we climb higher and higher among the super-imposed strata more perfect forms appear. The change, however, from form to form was not continuous—but by steps, some small, some great. "A section," says Mr. Huxley, "a hundred feet thick will exhibit at different heights a dozen species of ammonite, none of which passes beyond its particular zone of limestone, or clay, into the zone below it, or into that above it." In the presence of such facts it was not possible to avoid the question:—Have these forms, showing, though in broken stages and with many irregularities, this unmistakable general advance, been subjected to no continuous law of growth or variation? Had our education been purely scientific, or had it been sufficiently detached from influences which, however ennobling in another domain, have always proved hindrances and delusions when introduced as factors into the domain of physics, the scientific mind never could have swerved from the search for a law of growth, or allowed itself to accept the anthropomorphism which regarded each successive stratum as a kind of mechanic's bench for the manufacture of new species out of all relation to the old.

Biassed, however, by their previous education, the great majority of naturalists invoked a special creative act to account for the appearance of each new group of organisms. Doubtless there were numbers who were clear-headed enough to see that this was no explanation at all, that in point of fact it was an attempt, by the introduction of a greater difficulty, to account for a less. But, having nothing to offer in the way of explanation, they for the most part held their peace. Still the thoughts of reflecting men naturally and necessarily simmered round the question. De Maillet, a contemporary of Newton, has been brought into notice by Professor Huxley as one who "had a notion of the modifiability of living forms." In my frequent conversations with him, the late Sir Benjamin Brodie, a man of highly philosophic mind, often drew my attention to the fact that, as early as 1794, Charles Darwin's grandfather was the pioneer of Charles Darwin. In 1801, and in subsequent years, the celebrated Lamarck, who produced so profound an impression on the public mind through the vigorous exposition of his views by the author of the "Vestiges of Creation," endeavoured to show the development of species out of changes of habit and external condition. In 1813 Dr. Wells, the founder of our present theory of dew, read before the Royal Society a paper in which, to use the words of Mr. Darwin, "he distinctly recognises the principle of natural selection; and this is the first recognition that has been indicated." The thoroughness and skill with which Wells pursued his work, and the obvious independence of his character, rendered him long ago a favourite with me; and it gave me the liveliest pleasure to alight upon this additional testimony to his penetration. Professor Grant, Mr. Patrick Matthew, Von Buch, the author of the "Vestiges," D'Halloy, and others,[*] by the enunciation of views more or less clear and correct, showed that the question had been fermenting long prior to the year 1858, when Mr. Darwin and Mr. Wallace simultaneously, but independently, placed their closely concurrent views upon the subject before the Linnean Society.

These papers were followed in 1859 by the publication of the first edition of "The Origin of Species." All great things come slowly to the birth. Copernicus, as I informed you, pondered his great work for thirty-three years. Newton for nearly twenty years kept the idea of gravitation before his mind; for twenty years, also, he dwelt upon his discovery of Fluxions, and doubtless would have continued to make it the object of his private thought had he not found that Leibnitz was upon his track. Darwin for two-and-twenty years pondered the problem of the origin of species, and doubtless he would have continued to do so had he not found Wallace upon his track.* A concentrated, but full and powerful, epitome of his labours was the consequence. The book was by no means an easy one; and probably not one in every score of those who then attacked it had read its pages through, or were competent to grasp their significance if they had. I do not say this merely to discredit them; for there were in those days some really eminent scientific men, entirely raised above the heat of popular prejudice, willing to accept any conclusion that science had to offer, provided it was duly backed by fact and argument, and who entirely mistook Mr. Darwin's views. In fact, the work needed an expounder; and it found one in Mr. Huxley. I know nothing more admirable in the way of scientific exposition than those early articles of his on the origin of species. He swept the curve of discussion through the really significant points of the subject, enriched his exposition with profound original remarks and reflections, often summing up in a single pithy sentence an argument which a less compact mind would have spread over pages. But there is one impression made by the book itself which no exposition of it, however luminous, can convey; and that is, the impression of the vast amount of labour, both of observation and of thought, implied in its production. Let us glance at its principles.

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[*] Only to some; for there are dignitaries who even now speak of the earth's rocky crust as so much building material prepared for man at the Creation. Surely it is time that this loose language should cease.

[*] In 1855, Mr. Herbert Spencer ("Principles of Psychology," 2nd edition, vol. i., p. 465) expressed "the belief that life under all its forms has arisen by an unbroken evolution, and through the instrumentality of what are called natural causes."

It is conceded on all hands that what are called varieties are continually produced. The rule is probably without exception. No chick and no child is in all respects and particulars the counterpart of its brother or sister; and in such differences we have "variety" incipient. No naturalist could tell how far this variation could be carried; but the great mass of them held that never by any amount of internal or external change, nor by the mixture of both, could the offspring of the same progenitor so far deviate from each other as to constitute different species. The function of the experimental philosopher is to combine the conditions of nature and to produce her results; and this was the method of Darwin.† He made himself acquainted with what could, without any manner of doubt, be done in the way of producing variation. He associated himself with pigeon-fanciers—bought, begged, kept, and observed every breed that he could obtain. Though derived from a common stock, the diversities of these pigeons were such that "a score of them might be chosen which, if shown to an ornithologist, and he were told that they were wild birds, would certainly be ranked by him as well-defined species." The simple principle which guides the pigeon-fancier, as it does the cattle-breeder, is the selection of some variety that strikes his fancy, and the propagation of this variety by inheritance. With his eye still upon the particular appearance which he wishes to exaggerate, he selects it as it reappears in successive broods, and thus adds increment to increment until an astonishing amount of divergence from the parent type is effected. Man in this case does not produce the *elements* of the variation. He simply observes them, and by selection adds them together until the required result has been obtained. "No man," says Mr. Darwin, "would ever try to make a fantail till he saw a pigeon with a tail developed in some slight degree in an unusual manner, or a pouter until he saw a pigeon with a crop of unusual size." Thus nature gives the hint, man acts upon it, and by the law of inheritance exaggerates the deviation.

Having thus satisfied himself by indubitable facts that the organisation of an animal or of a plant (for precisely the same treatment applies to plants) is to some extent plastic, he passes from variation under domestication to variation under nature. Hitherto we have dealt with the adding together of small changes by the conscious selection of man. Can Nature thus select? Mr. Darwin's answer is, "Assuredly she can." The number of living things produced is far in excess of the number that can be supported; hence at some period or other of their lives there must be a struggle for existence; and what is the infallible result? If one organism were a perfect copy of the other in regard to strength, skill, and agility, external conditions would decide. But this is not the case. Here we have the fact of variety offering itself to nature, as in the former instance it offered itself to man; and those varieties which are least competent to cope with surrounding conditions will infallibly give way to those that are most competent. To use a familiar proverb, the weakest comes to the wall. But the triumphant fraction again breeds to over-production, transmitting the qualities which secured its maintenance, but transmitting them in different degrees. The struggle for food again supervenes, and those to whom the favourable quality has been transmitted in excess will assuredly triumph. It is easy to see that we have here the addition of increments favourable to the individual still more rigorously carried out than in the case of domestication; for not only are unfavourable specimens not selected by nature, but they are destroyed. This is what Mr. Darwin calls "Natural Selection," which "acts by the preservation and accumulation of small inherited modifications, each profitable to the preserved being." With this idea he interpenetrates and leavens the vast store of facts that he and others have collected. We cannot, without shutting our eyes through fear or prejudice, fail to see that Darwin is here dealing, not with imaginary, but with true causes; nor can we fail to discern what vast modifications may be produced by natural selection in periods sufficiently long. Each individual increment may resemble what mathematicians call a "differential" (a quantity indefinitely small); but definite and great changes may obviously be produced by the integration of these infinitesimal quantities through practically infinite time.

If Darwin, like Bruno, rejects the notion of creative power acting after human fashion, it certainly is not because he is unacquainted with the numberless exquisite adaptations on which this notion of a supernatural artificer has been founded. His book is a repository of the most startling facts of this description. Take the marvellous observation which he cites from Dr. Crüger, where a bucket with an aperture, serving as a spout, is formed in an orchid. Bees visit the flower: in eager search of material for their combs they push each other into the bucket, the drenched ones escaping from their involuntary bath by the spout. Here they rub their backs against the viscid stigma of the flower and obtain glue; then against the pollen-masses, which are thus stuck to the back of the bee and carried away. "When the bee, thus provided, flies to another flower, or to the same flower a second time, and is pushed by its comrades into the bucket, and then crawls out by the passage, the pollen-mass upon its back necessarily comes first into contact with the viscid stigma," which takes up the pollen; and this is how that orchid is fertilised. Or take this other case of the *Catasetum*. "Bees visit these flowers in order to gnaw the labellum; on doing this they inevitably touch a long, tapering, sensitive projection. This, when touched, transmits a sensation or vibration to a certain membrane, which is instantly ruptured, setting free a spring, by which the pollen-mass is shot forth like an arrow in the right direction, and adheres by its viscid extremity to the back of the bee." In this way the fertilising pollen is spread abroad.

It is the mind thus stored with the choicest materials of the teleologist that rejects teleology, seeking to refer these wonders to natural causes. They illustrate, according to him, the method of nature, not the "technic" of a man-like Artificer. The beauty of flowers is due to natura selection. Those that distinguish themselves by vividly contrasting colours from the surrounding green leaves are most readily seen, most frequently visited by insects, most often fertilised, and hence most favoured by natural selection. Coloured berries also readily attract the attention of birds and beasts, which feed upon them, spread their manured seeds abroad, thus giving trees and shrubs possessing such berries a greater chance in the struggle for existence.

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* The behaviour of Mr. Wallace in relation to this subject has been dignified in the highest degree.

† The first step only towards experimental demonstration has been taken. Experiments now begun might, a couple of centuries hence, nish data of incalculable value, which ought to be supplied to the se of the future.

With profound analytic and synthetic skill, Mr. Darwin investigates the cell-making instinct of the hive-bee. His method of dealing with it is representative. He falls back from the more perfectly to the less perfectly developed instinct—from the hive-bee to the humble bee, which uses its own cocoon as a comb, and to classes of bees of intermediate skill, endeavouring to show how the passage might be gradually made from the lowest to the highest. The saving of wax is the most important point in the economy of bees. Twelve to fifteen pounds of dry sugar are said to be needed for the secretion of a single pound of wax. The quantities of nectar necessary for the wax must therefore be vast; and every improvement of constructive instinct which results in the saving of wax is a direct profit to the insect's life. The time that would otherwise be devoted to the making of wax is now devoted to the gathering and storing of honey for winter food. He passes from the humble bee with its rude cells, through the Melipona with its more artistic cells, to the hive-bee with its astonishing architecture. The bees place themselves at equal distances apart upon the wax, sweep and excavate equal spheres round the selected points. The spheres intersect, and the planes of intersection are built up with thin laminæ. Hexagonal cells are thus formed. This mode of treating such questions is, as I have said, representative. He habitually retires from the more perfect and complex, to the less perfect and simple, and carries you with him through stages of *perfecting*, adds increment to increment of infinitesimal change, and in this way gradually breaks down your reluctance to admit that the exquisite climax of the whole could be a result of natural selection.

Mr. Darwin shirks no difficulty; and, saturated as the subject was with his own thought, he must have known, better than his critics, the weakness as well as the strength of his theory. This of course would be of little avail were his object a temporary dialectic victory instead of the establishment of a truth which he means to be everlasting. But he takes no pains to disguise the weakness he has discerned; nay, he takes every pains to bring it into the strongest light. His vast resources enable him to cope with objections started by himself and others, so as to leave the final impression upon the reader's mind that, if they be not completely answered, they certainly are not fatal. Their negative force being thus destroyed, you are free to be influenced by the vast positive mass of evidence he is able to bring before you. This largeness of knowledge and readiness of resource render Mr. Darwin the most terrible of antagonists. Accomplished naturalists have levelled heavy and sustained criticisms against him—not always with the view of fairly weighing his theory, but with the express intention of exposing its weak points only. This does not irritate him. He treats every objection with a soberness and thoroughness which even Bishop Butler might be proud to imitate, surrounding each fact with its appropriate detail, placing it in its proper relations, and usually giving it a significance which, as long as it was kept isolated, failed to appear. This is done without a trace of ill-temper. He moves over the subject with the passionless strength of a glacier; and the grinding of the rocks is not always without a counterpart in the logical pulverisation of the objector. But though in handling this mighty theme all passion has been stilled, there is an emotion of the intellect incident to the discernment of new truth which often colours and warms the pages of Mr. Darwin. His success has been great; and this implies not only the solidity of his work, but the preparedness of the public mind for such a revelation. On this head a remark of Agassiz impressed me more than anything else. Sprung from a race of theologians, this celebrated man combated to the last the theory of natural selection. One of the many times I had the pleasure of meeting him in the United States was at Mr. Winthrop's beautiful residence at Brookline, near Boston. Rising from luncheon, we all halted as if by a common impulse in front of a window, and continued there a discussion which had been started at table. The maple was in its autumn glory; and the exquisite beauty of the scene outside seemed, in my case, to interpenetrate without disturbance the intellectual action. Earnestly, almost sadly, Agassiz turned, and said to the gentlemen standing round, "I confess that I was not prepared to see this theory received as it has been by the best intellects of our time. Its success is greater than I could have thought possible."

In our day great generalisations have been reached. The theory of the origin of species is but one of them. Another, of still wider grasp and more radical significance, is the doctrine of the Conservation of Energy, the ultimate philosophical issues of which are as yet but dimly seen—that doctrine which "binds nature fast in fate" to an extent not hitherto recognised, exacting from every antecedent its equivalent consequent, from every consequent its equivalent antecedent, and bringing vital as well as physical phenomena under the dominion of that law of causal connection which, as far as the human understanding has yet pierced, asserts itself everywhere in nature. Long in advance of all definite experiment upon the subject, the constancy and indestructibility of matter had been affirmed; and all subsequent experience justified the affirmation. Later researches extended the attribute of indestructibility to force. This idea, applied in the first instance to inorganic, rapidly embraced organic nature. The vegetable world, though drawing almost all its nutriment from invisible sources, was proved incompetent to generate anew either matter or force. Its matter is for the most part transmuted air; its force transformed solar force. The animal world was proved to be equally uncreative, all its motive energies being referred to the combustion of its food. The activity of each animal as a whole was proved to be the transferred activities of its molecules. The muscles were shown to be stores of mechanical force, potential until unlocked by the nerves, and then resulting in muscular contractions. The speed at which messages fly to and fro along the nerves was determined, and found to be, not as had been previously supposed, equal to that of light or electricity, but less than the speed of a flying eagle.

This was the work of the physicist: then came the conquests of the comparative anatomist and physiologist, revealing the structure of every animal, and the function of every organ in the whole biological series, from the lowest zoophyte up to man. The nervous system had been made the object of profound and continued study, the wonderful and, at bottom, entirely mysterious, controlling power which it exercises over the whole organism, physical and mental, being recognised more and more. Thought could not be kept back from a subject so profoundly suggestive. Besides the physical life dealt with by Mr. Darwin, there is a psychical life presenting similar gradations, and asking equally for a solution. How are the different grades and orders of Mind to be accounted for? What is the principle of growth of that mysterious power which on our planet culminates in reason? These are questions which, though not thrusting themselves so forcibly upon the attention of the general public, had not only occupied many reflecting minds, but had been formally broached by one of them before the "Origin of Species" appeared.

With the mass of materials furnished by the physicist and physiologist in his hands, Mr. Herbert Spencer, twenty years ago, sought to graft upon this basis a system of psychology; and two years ago a second and greatly amplified edition of his work appeared. Those who have occupied themselves with the beautiful experiments of Plateau will remember that when two spherules of olive-oil, suspended in a mixture of alcohol and water of the same density of the oil, are brought together, they do not immediately unite. Something like a pellicle appears to be formed around the drops, the rupture of which is immediately followed by the coalescence of the globules into one. There are organisms whose vital actions are almost as purely physical as that of these drops of oil. They come into contact and fuse themselves thus together. From such organisms to other a shade higher, and from these to others a shade higher still, and on through an ever ascending series, Mr. Spencer conducts his argument. There are two obvious factors to be here taken into account—the creature and the medium in which it lives, or, as it is often expressed, the organism and its environment. Mr. Spencer's fundamental principle is, that between these two factors there is incessant interaction. The organism is played upon by the environment, and is modified to meet the requirements of the environment. Life he defines to be "a continuous adjustment of internal relations to external relations."

In the lowest organisms we have a kind of tactual sense diffused over the entire body; then, through impressions from without and their corresponding adjustments, special portions of the surface become more responsive to stimuli than others. The senses are nascent, the basis of all of them being that simple tactual sense which the sage Democritus recognised 2300 years ago as their common progenitor. The action of light, in the first instance, appears to be a mere disturbance of the chemical processes in the animal organism, similar to that which occurs in the leaves of plants. By degrees the action becomes localised in a few pigment-cells, more sensitive to light than the surrounding tissue. The eye is here incipient. At first it is merely capable of revealing differences of light and shade produced by bodies close at hand. Followed as the interception of the light is, in almost all cases, by the contact of the closely adjacent opaque body, sight in this condition becomes a kind of "anticipatory touch." The adjustment continues; a slight bulging out of the epidermis over the pigment-granules supervenes. A lens is incipient, and, through the operation of infinite adjustments, at length reaches the perfection that it displays in the hawk and eagle. So of the other senses; they are special differentiations of a tissue which was originally vaguely sensitive all over.

With the development of the senses the adjustments between the organism and its environment gradually extend in *space*, a multiplication of experiences and a corresponding modification of conduct being the result. The adjustments also extend in *time*, covering continually greater intervals. Along with this extension in space and time the adjustments also increase in speciality and complexity, passing through the various grades of brute life, and prolonging themselves into the domain of reason. Very striking are Mr. Spencer's remarks regarding the influence of the sense of touch upon the development of intelligence. This is, so to say, the mother-tongue of all the senses, into which they must be translated to be of service to the organism. Hence its importance. The parrot is the most intelligent of birds, and its tactual power is also greatest. From this sense it gets knowledge unattainable by birds which cannot employ their feet as hands. The elephant is the most sagacious of quadrupeds,—its tactual range and skill, and the consequent multiplication of experiences, which it owes to its wonderfully adaptable trunk, being the basis of its sagacity. Feline animals, for a similar cause, are more sagacious than hoofed animals,—atonement being to some extent made, in the case of the horse, by the possession of sensitive prehensile lips. In the *Primates* the evolution of intellect and the evolution of tactual appendages go hand in hand. In the most intelligent anthropoid apes we find the tactual range and delicacy greatly augmented, new avenues of knowledge being thus opened to the animal. Man crowns the edifice here, not only in virtue of his own manipulatory power, but through the enormous extension of his range of experience, by the invention of instruments of precision, which serve as supplemental senses and supplemental limbs. The reciprocal action of these is finely described and illustrated. That chastened intellectual emotion to which I have referred in connection with Mr. Darwin is, I should say, not absent in Mr. Spencer. His illustrations possess at times exceeding vividness and force; and from his style on such occasions it is to be inferred that the ganglia of this Apostle of the Understanding are sometimes the seat of a nascent poetic thrill.

It is a fact of supreme importance that actions the performance of which at first requires even painful effort and deliberation, may by habit be rendered automatic. Witness the slow learning of its letters by a child, and the subsequent facility of reading in a man, when each group of letters which forms a word is instantly, and without effort, fused to a single perception. Instance the billiard-player, whose muscles of hand and eye, when he reaches the perfection of his art, are unconsciously co-ordinated. Instance the musician, who, by practice, is enabled to fuse a multitude of arrangements, auditory, tactual, and muscular, into a process of automatic manipulation. Combining such facts with the doctrine of hereditary transmission, we reach a theory of Instinct. A chick, after coming out of the egg, balances itself correctly, runs about, picks up food, thus showing that it possesses a power of directing its movements to definite ends. How did the chick learn this very complex co-ordination of eye, muscles, and beak? It has not been individually taught; its personal experience is *nil*; but it has the benefit of ancestral experience. In its inherited organisation are registered all the powers which it displays at birth. So also as regards the instinct of the hive-bee, already referred to. The distance at which the insects stand apart when they sweep their hemispheres and build their cells is "organically remembered." Man also carries with him the physical texture of his ancestry, as well as the inherited intellect bound up with it. The defects of intelligence during infancy and youth are probably less due to a lack of individual experience than to the fact that in early life the cerebral organisation is still incomplete. The period necessary for completion varies with the race, and with the individual. As a round shot outstrips a rifled one on quitting the muzzle of the gun, so the lower race in childhood may outstrip the higher. But the higher eventually overtakes the lower, and surpasses it in range. As regards individuals, we do not always find the precocity of youth prolonged to mental power in maturity; while the dulness of boyhood is sometimes strikingly contrasted with the intellectual energy of after years. Newton, when a boy, was weakly, and he showed no particular aptitude at school; but in his eighteenth year he went to Cambridge, and soon afterwards astonished his teachers by his power of dealing with geometrical problems. During his quiet youth his brain was slowly preparing itself to be the organ of those energies which he subsequently displayed.

By myriad blows (to use a Lucretian phrase) the image and superscription of the external world are stamped as states of consciousness upon the organism, the depth of the impression depending upon the number of the blows. When two or more phenomena occur in the environment invariably together, they are stamped to the same depth or to the same relief, and indissolubly connected. And here we come to the threshold of a great question. Seeing that he could in no way rid himself of the consciousness of Space and Time, Kant assumed them to be necessary "forms of thought," the moulds and shapes into which our intuitions are thrown belonging to ourselves solely, and without objective existence. With unexpected power and success Mr. Spencer brings the hereditary experience theory, as he holds it, to bear upon this question. "If there exist certain external relations which are experienced by all organisms at all instants of their waking lives—relations which are absolutely constant and universal—there will be established answering internal relations that are absolutely constant and universal. Such relations we have in those of Space and Time. As the substratum of all other relations of the Non-Ego, they must be responded to by conceptions that are the substrata of all other relations in the Ego. Being the constant and infinitely repeated elements of thought, they must become the automatic elements of thought,—the elements of thought which it is impossible to get rid of,—the 'forms of intuition.'"

Throughout this application and extension of the "Law of Inseparable Association," Mr. Spencer stands on totally different ground from Mr. John Stuart Mill, invoking the registered experiences of the race instead of the experiences of the individual. His overthrow of Mr. Mill's restriction of experience is, I think, complete. That restriction ignores the power of organising experience furnished at the outset to each individual; it ignores the different degrees of this power possessed by different races and by different individuals of the same race. Were there not in the human brain a potency antecedent to all experience, a dog or cat ought to be as capable of education as a man. These predetermined internal relations are independent of the experiences of the individual. The human brain is the "organised register of infinitely numerous experiences received during the evolution of life, or rather during the evolution of that series of organisms through which the human organism has been reached. The effects of the most uniform and frequent of these experiences have been successively bequeathed, principal and interest, and have slowly mounted to that high intelligence which lies latent in the brain of the infant. Thus it happens that the European inherits from 20 to 30 cubic inches more of brain than the Papuan. Thus it happens that faculties, as of music, which scarcely exist in some inferior races, become congenital in superior ones. Thus it happens that out of savages unable to count up to the nnmber of their fingers, and speaking a language containing only nouns and verbs, arise at length our Newtons and Shakspeares."

At the outset of this Address it was stated that physical theories which lie beyond experience are derived by a process of abstraction from experience. It is instructive to note from this point of view the successive introduction of new conceptions. The idea of the attraction of gravitation was preceded by the observation of the attraction of iron by a magnet, and of light bodies by rubbed amber. The polarity of magnetism and electricity appealed to the senses; and thus became the substratum of the conception that atoms and molecules are endowed with definite, attractive and repellent poles, by the play of which definite forms of crystalline architecture are produced. Thus molecular force becomes *structural*. It required no great boldness of thought to extend its play into organic nature, and to recognise in molecular force the agency by which both plants and animals are built up. In this way out of experience arise conceptions which are wholly ultra-experiential.

The *origination* of life is a point lightly touched upon, if at all, by Mr. Darwin and Mr. Spencer. Diminishing gradually the number of progenitors, Mr. Darwin comes at length to one "primordial form;" but he does not say, as far as I remember, how he supposes this form to have been introduced. He quotes with satisfaction the words of a celebrated author and divine who had "gradually learnt to see that it is just as noble a conception of the Deity to believe He created a few original forms, capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws." What Mr. Darwin thinks of this view of the introduction of life I do not know. Whether he does or does not introduce his "primordial form" by a creative act, I do not know. But the question will inevitably be asked, "How came the form there?" With regard to the diminution of the number of created forms, one does not see that much advantage is gained by it. The anthropomorphism, which it seemed the object of Mr. Darwin to set aside, is as firmly associated with the creation of a few forms as with the creation of a multitude. We need clearness and thoroughness here. Two courses, and two only, are possible. Either let us open our doors freely to the conception of creative acts, or, abandoning them, let us radically change our notions of Matter. If we look at matter as pictured by Democritus, and as defined for generations in our scientific text-books, the absolute impossibility of any form of life coming out of it would be sufficient to render any other hypothesis preferable; but the definitions of matter given in our text-books were intended to cover its purely physical and mechanical properties. And taught as we have been to regard these definitions as complete, we naturally and rightly reject the monstrous notion that out of *such* matter any form of life could possibly arise. But are the definitions complete? Everything depends on the answer to be given to this question. Trace the line of life backwards, and see it approaching more and more to what we call the purely physical condition. We reach at length those organisms which I have compared to drops of oil suspended in a mixture of alcohol and water. We reach the *protogenes* of Haeckel, in which we have "a type distinguishable from a fragment of albumen only by its finely granular character." Can we pause here? We break a magnet, and find two poles in each of its fragments. We continue the process of breaking, but however small the parts each carries with it, though enfeebled, the polarity of the whole. And when we can break no longer, we prolong the intellectual vision to the polar molecules. Are we not urged to do *something* similar in the case of life? Is there not a temptation to close to some extent with Lucretius, when he affirms that "Nature is seen to do all things spontaneously of herself without the meddling of the gods?" or with Bruno, when he declares that Matter is not "that mere empty *capacity* which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb?" The questions here raised are inevitable. They are approaching us with accelerated speed, and it is not a matter of indifference whether they are introduced with reverence or with irreverence. Abandoning all disguise, the confession that I feel bound to make before you is that I prolong the vision backward across the boundary of the experimental evidence, and discern in that Matter which we in our ignorance—and notwithstanding our professed reverence for its Creator—have hitherto covered with opprobrium, the promise and potency of every form and quality of Life.

The "materialism" here enunciated may be different from what you suppose, and I therefore crave your gracious patience to the end. "The question of an external world," says Mr. J. S. Mill, "is the great battle-ground of metaphysics."* Mr. Mill himself reduces external phenomena to "possibilities of sensation." Kant, as we have seen, made time and space "forms" of our own intuitions. Fichte, having first by the inexorable logic of his understanding proved himself to be a mere link in that chain of eternal causation which holds so rigidly in nature, violently broke the chain by making nature, and all that it inherits, an apparition of his own mind.† And it is by no means easy to combat such notions. For when I say I see you, and that I have not the least doubt about it, the reply is, that what I am really conscious of is an affection of my own retina. And if I urge that I can check my sight of you by touching you, the retort would be that I am equally transgressing the limits of fact; for what I am really conscious of is, not that you are there, but that the nerves of my hand have undergone a change. All we hear, and see, and touch, and taste, and smell, are, it would be urged, mere variations of our own condition, beyond which, even to the extent of a hair's breadth, we cannot go. That anything answering to our impressions exists outside of ourselves is not a *fact*, but an *inference*, to which all validity would be denied by an idealist like Berkeley, or by a sceptic like Hume. Mr. Spencer takes another line. With him, as with the uneducated man, there is no doubt or question as to the existence of an external world. But he differs from the uneducated, who think that the world really *is* what consciousness represents it to be. Our states of consciousness are mere *symbols* of an outside entity which produces them and determines the order of their succession, but the real nature of which we can never know.* In fact, the whole process of evolution is the manifestation of a Power absolutely inscrutable to the intellect of man. As little in our day as in the days of Job can man by searching find this Power out. Considered fundamentally, it is by the operation of an insoluble mystery that life is evolved, species differentiated, and mind unfolded from their prepotent elements in the immeasurable past. There is, you will observe, no very rank materialism here.

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* "Examination of Hamilton," p. 154.

† "Bestimmung des Menschen."

The strength of the doctrine of evolution consists, not in an experimental demonstration (for the subject is hardly accessible to this mode of proof), but in its general harmony with the method of nature as hitherto known. From contrast, moreover, it derives enormous relative strength. On the one side we have a theory (if it could with any propriety be so called) derived, as were the theories referred to at the beginning of this Address, not from the study of nature, but from the observation of men —a theory which converts the Power whose garment is seen in the visible universe into an Artificer, fashioned after the human model, and acting by broken efforts as man is seen to act. On the other side we have the conception that all we see around us, and all we feel within us—the phenomena of physical nature as well as those of the human mind—have their unsearchable roots in a cosmical life, if I dare apply the term, an infinitesimal span of which only is offered to the investigation of man. And even this span is only knowable in part. We can trace the development of a nervous system, and correlate with it the parallel phenomena of sensation and thought. We see with undoubting certainty that they go hand in hand. But we try to soar in a vacuum the moment we seek to comprehend the connection between them. An Archimedean fulcrum is here required which the human mind cannot command; and the effort to solve the problem, to borrow an illustration from an illustrious friend of mine, is like the effort of a man trying to lift himself by his own waistband. All that has been here said is to be taken in connection with this fundamental truth. When "nascent senses" are spoken of, when "the differentiation of a tissue at first vaguely sensitive all over is spoken of," and when these processes are associated with "the modification of an organism by its environment," the same parallelism, without contact, or even approach to contact, is implied. There is no fusion possible between the two classes of facts—no motor energy in the intellect of man to carry it without logical rupture from the one to the other.

Further, the doctrine of evolution derives man, in his totality, from the inter-action of organism and environment through countless ages past. The human understanding, for example—that faculty which Mr. Spencer has turned so skilfully round upon its own antecedents—is itself a result of the play between organism and environment through cosmic ranges of time. Never, surely, did prescription plead so irresistible a claim. But then it comes to pass that, over and above his understanding, there are many other things appertaining to man whose prescriptive rights are quite as strong as that of the understanding itself. It is a result, for example, of the play of organism and environment that sugar is sweet and that aloes are bitter, that the smell of henbane differs from the perfume of a rose. Such facts of consciousness (for which, by the way, no adequate reason has ever yet been rendered) are quite as old as the understanding itself; and many other things can boast an equally ancient origin. Mr. Spencer at one place refers to that most powerful of passions—the amatory passion—as one which, when it first occurs, is antecedent to all relative experience whatever; and we may pass its claim as being at least as ancient and as valid as that of the understanding itself. Then there are such things woven into the texture of man as the feeling of awe, reverence, wonder,—and not alone the sexual love just referred to, but the love of the beautiful, physical and moral, in Nature, poetry, and art. There is also that deep-set feeling which, since the earliest dawn of history, and probably for ages prior to all history, incorporated itself in the Religions of the world. You who have escaped from these religions into the high-and-dry light of the understanding may deride them; but in so doing you deride accidents of form merely, and fail to touch the immovable basis of the religious sentiment in the emotional nature of man. To yield to this sentiment reasonable satisfaction is the problem of problems at the present hour. And grotesque in relation to scientific culture as many of the religions of the world have been and are—dangerous, nay destructive, to the dearest privileges of freemen as some of them undoubtedly have been, and would, if they could, be again,—it will be wise to recognise them as the forms of a force, mischievous if permitted to intrude on the region of *knowledge*, over which it holds no command, but capable of being guided by liberal thought to noble issues in the region of *emotion*, which is its proper sphere. It is vain to oppose this force with a view to its extirpation. What we should oppose, to the death if necessary, is every attempt to found upon this elemental bias of man's nature a system which should exercise despotic sway over his intellect. I do not fear any such consummation. Science has already to some extent leavened the world, and it will leaven it more and more. I should look upon the mild light of science breaking in upon the minds of the youth of Ireland, and strengthening gradually to the perfect day, as a surer check to any intellectual or spiritual tyranny which might threaten this island, than the laws of princes or the swords of emperors. Where is the cause of fear? We fought and won our battle even in the Middle Ages: why should we doubt the issue of a conflict now?

The impregnable position of science may be described in a few words. All religious theories, schemes, and systems, which embrace notions of cosmogony, or which otherwise reach into its domain, must, in so far as they do this, submit to the control of science, and relinquish all thought of controlling it. Acting otherwise proved disastrous in the past, and it is simply fatuous to-day. Every system which would escape the fate of an organism too rigid to adjust itself to its environment, must be plastic to the extent that the growth of knowledge demands. When this truth has been thoroughly taken in, rigidity will be relaxed, exclusiveness diminished, things now deemed essential will be dropped, and elements now rejected will be assimilated. The lifting of the life is the essential point; and, as long as dogmatism, fanaticism, and intolerance are kept out, various modes of leverage may be employed to raise life to a higher level. Science itself not unfrequently derives motive power from an ultra-scientific source. Whewell speaks of enthusiasm of temper as a hindrance to science; but he means the enthusiasm of weak heads. There is a strong and resolute enthusiasm in which science finds an ally; and it is to the lowering of this fire, rather than to a diminution of intellectual insight, that the lessening productiveness of men of science in their mature years is to be ascribed. Mr. Buckle sought to detach intellectual achievement from moral force. He gravely erred; for without moral force to whip it into action, the achievements of the intellect would be poor indeed.

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* In a paper, at once popular and profound, entitled "Recent Progress in the Theory of Vision," contained in the volume of Lectures by Helmholtz, published by Longmans, this symbolism of our states of consciousness is also dwelt upon. The impressions of sense are the mere *signs* of external things. In this paper Helmholtz contends strongly against the view that the consciousness of space is inborn, and he evidently doubts the power of the chick to pick up grains of corn without some preliminary lessons. On this point, he says, further experiments are needed. Such experiments have been since made by Mr. Spalding, aided, I believe, in some of his observations by the accomplished and deeply lamented Lady Amberly; and they seem to prove conclusively that the chick does not need a single moment's tuition to teach it to stand, run, govern the muscles of its eyes, and peck. Helmholtz, however, is contending against the notion of pre-established harmony; and I am not aware of his views as to the organisation of experiences of race or breed.

It has been said that science divorces itself from literature: the statement, like so many others, arises from lack of knowledge. A glance at the less technical writings of its leaders—of its Helmholtz, its Huxley, and its Du Bois-Reymond—would show what breadth of literary culture they command. Where among modern writers can you find their superiors in clearness, and vigour of literary style? Science desires not isolation, but freely combines with every effort towards the bettering of man's estate. Single-handed, and supported not by outward sympathy, but by inward force, it has built at least one great wing of the many-mansioned home which man in his totality demands. And, if rough walls and protruding rafter-ends indicate that on one side the edifice is still incomplete, it is only by wise combination of the parts required, with those already irrevocably built, that we can hope for completeness. There is no necessary incongruity between what has been accomplished and what remains to be done. The moral glow of Socrates, which we all feel by ignition, has in it nothing incompatible with the physics of Anaxagoras which he so much scorned, but which he would hardly scorn to-day. And here I am reminded of one amongst us, hoary, but still strong, whose prophet-voice some thirty years ago, far more than any other of this age, unlocked whatever of life and nobleness lay latent in its most gifted minds—one fit to stand beside Socrates or the Maccabean Eleazar, and to dare and suffer all that they suffered and dared—fit, as he once said of Fichte, "to have been the teacher of the Stoa, and to have discoursed of Beauty and Virtue in the groves of Academe." With a capacity to grasp physical principles which his friend Goethe did not possess, and which even total lack of exercise has not been able to reduce to atropy, it is the world's loss that he, in the vigour of his years, did not open his mind and sympathies to science, and make his conclusions a portion of his message to mankind. Marvellously endowed as he was—equally equipped on the side of the heart and of the understanding—he might have done much towards teaching us how to reconcile the claims of both, and to enable them in coming times to dwell together in unity of spirit and in the bond of peace.

And now the end is come. With more time, or greater strength and knowledge, what has been here said might have been better said, while worthy matters here omitted might have received fit expression. But there would have been no material deviation from the views set forth. As regards myself, they are not the growth of a day; and as regards you, I thought you ought to know the environment which, with or without your consent, is rapidly surrounding you, and in relation to which some adjustment on your part may be necessary. A hint of Hamlet's, however, teaches us all how the troubles of common life may be ended; and it is perfectly possible for you and me to purchase intellectual peace at the price of intellectual death. The world is not without refuges of this description: nor is it wanting in persons who seek their shelter and try to persuade others to do the same. I would exhort you to refuse such shelter, and to scorn such base repose—to accept, if the choice be forced upon you, commotion before stagnation, the leap of the torrent before the stillness of the swamp. In the one there is at all events life and, therefore, hope; in the other none. I have touched on debatable questions, and led you over dangerous ground—and this partly with the view of telling you, and through you the world, that as regards these questions science claims unrestricted right of search. It is not to the point to say that the views of Lucretius and Bruno, of Darwin and Spencer, may be wrong. I concede the possibility, deeming it indeed certain that these views will undergo modification. But the point is, that whether right or wrong, we claim the freedom to discuss them. The ground which they cover is scientific ground; and the right claimed is one made good through tribulation and anguish, inflicted and endured in darker times than ours, but resulting in the immortal victories which science has won for the human race. I would set forth equally the inexorable advance of man's understanding in the path of knowledge, and the unquenchable claims of his emotional nature which the understanding can never satisfy. The world embraces not only a Newton, but a Shakspeare—not only a Boyle, but a Raphael—not only a Kant, but a Beethoven—not only a Darwin, but a Carlyle. Not in each of these, but in all, is human nature whole. They are not opposed, but supplementary—not mutually exclusive, but reconcilable. And if, still unsatisfied, the human mind, with the yearning of a pilgrim for his distant home, will turn to the Mystery from which it has emerged, seeking so to fashion it as to give unity to thought and faith, so long as this is done, not only without intolerance or bigotry of any kind, but with the enlightened recognition that ultimate fixity of conception is here unattainable, and that each succeeding age must be held free to fashion the mystery in accordance with its own needs—then, in opposition to all the restrictions of Materialism, I would affirm this to be a field for the noblest exercise of what, in contrast with the *knowing* faculties, may be called the *creative* faculties of man. Here, however, I must quit a theme too great for me to handle, but which will be handled by the loftiest minds ages after you and I, like streaks of morning cloud, shall have melted into the infinite azure of the past.

Section B.

ADDRESS
TO THE
CHEMICAL SECTION.
August 20, 1874.

By A. CRUM BROWN, M.D., F.R.S.E., &c.,
President of the Section.

Gentlemen,—

One hundred years have elapsed since the discovery of oxygen by Priestley. Perhaps we should say re-discovery, for there is no doubt that about one hundred years earlier Mayow prepared from nitre nearly pure oxygen, and observed and recorded some of its most marked properties. Mayow's discovery, however, led to nothing; while Priestley's was the most important step in that re-construction of speculative chemistry which was commenced by Black and carried on with surprising energy and thoroughness by Lavoisier and his associates. I shall not detain you by enumerating the ways in which this discovery has affected chemistry, both practical and speculative. The pre-eminent position to which oxygen was at once elevated, and which it so long retained, makes this altogether unnecessary. I wish, however, to point out one character of the phlogistic controversy, which sharply distinguishes it from many others. The truth represented by the theory of Phlogiston was not recognised with sufficient distinctness by the supporters of that theory to give them any chance of success in opposition to a band of devoted adherents of a view which was clearly understood by all. The Phlogistists were completely defeated, and the theory ceased to exist. It has been left for chemical antiquaries to pick out, with difficulty and uncertainty, a meaning from the ruins.

I have mentioned this character because I wish to draw your attention to another, more recent, controversy, the result of which was very different.

The questions as to chemical constitution, raised about forty years ago by Dumas and the new French school in opposition to Berzelius, may now be said to be practically settled. The great majority of chemists are agreed as to what is to be understood by chemical constitution, and also as to the nature and amount of evidence required in order to determine the constitution of a substance. How has this agreement been produced? Some historical writers seem to wish us to believe that it is the result of the triumph of the ideas of Dumas, Gerhardt, and Laurent, and the defeat of the dualistic radical theory of Berzelius; that the arguments of Berzelius and his followers were only useful as giving occasion for a more full and convincing proof of the unitary substitution theory than would otherwise have been called for; that, in fact, the adherents of dualism played the part (not unfrequently supposed to be that of the conservative party in politics) of checking and criticising the successive developments of truth, and thus allowing them time to ripen.

In opposition to the view thus broadly stated, I would place another, and, for the sake of contrast, shall state it also in perhaps too broad a form. That the two theories—the dualistic radical theory and the unitary substitution theory—were both true and both imperfect; that they underwent gradual development, scarcely influenced by each other, until they have come to be almost identical in reference to points where they at one time seemed most opposed.

I have said that the development of the one theory was scarcely influenced by that of the other. Of course, the *facts* discovered by both parties were common property, and the development of both theories depended upon the discovery of these facts; but the explanations of facts, and the reasoning from them given by each party, seemed to the other scarcely worthy of serious consideration, and were treated as matter of ridicule. And the habit of mind created by this mode of viewing the opposed theory has rendered it difficult for those who were engaged in the controversy on either side to see how nearly the two theories have now come to coincidence. Their language still remains different; but, as the facts are the same for both, it is not difficult for a neutral critic to translate from the one to the other, and if we do so we shall see that there is much real agreement between the two modes of representing chemical ideas, historically derived, the one from Berzelius, the other from Dumas, Laurent, and Gerhardt.

In both, chemical constitution is regarded as *the order in which the constituents are united in the compound*, and the same fundamental notion is indicated in the one by reference to proximate constituents, in the other by the concatenation of atoms. To show that this is so, and that the fundamental notion can be arrived at from the dualistic, as well as from the unitary starting-point, I shall cite an illustrative case. Every student of chemical history will remember the view of the constitution of trichloracetic acid propounded by Berzelius, and afterwards supplemented by a similar view of the constitution of acetic acid, and an explanation of the likeness of some of the properties of these two substances. This has sometimes been spoken of as a subterfuge of a not very creditable kind, by means of which Berzelius apparently saved his consistency while really yielding to the arguments of his opponents. But if, instead of looking at it in the light of the substitution controversy, we consider it in itself as a contribution to speculative chemistry, we at once recognise in it a statement, in Berzelian language, of the views we now hold as to the constitution of these acids. The view was that acetic acid is a compound of oxalic acid and methyl, trichloracetic acid a compound of oxalic acid and the sesquichloride of carbon. They differ considerably from each other, because the "copulæ" (methyl and sesquichloride of carbon respectively) are different, but their resemblance is strongly marked, because they contain the same active constituent, oxalic acid, and most of the prominent characters of the substances depend upon it, and not upon the copula. Let us first free this statement from what we may call archaisms of language. It will then assume something like the following form:—The carbon in acetic acid is equally divided between two proximate constituents, one of which is an oxide, the other a hydride of carbon; trichloracetic acid similarly contains an oxide and a chloride of carbon, between which the carbon is equally divided. The oxide is the same in both acids, and is that oxide which occurs in oxalic acid. The hydride and the chloride have the composition of the substances the formulæ of which are C_2H_6 and C_2Cl_6 respectively. Oxalic acid undergoes chemical change much more readily than the corresponding hydride or chloride, and therefore the chemical character of acetic and of trichloracetic acids depends much more on the oxidised than on the other constituent, and they thus have a marked resemblance. The oxidised constituent is united to the other in a manner different from that in which oxalic acid is united to bases in the oxalates, inasmuch as, while the basic water of hydrated oxalic acid is displaced when oxalic acid unites with a base, in hydrated acetic and trichloracetic acids there is the same proportion between the basic water and the oxidised carbon as there is in oxalic acid.

Now has not this a great resemblance to the view entertained by most modern chemists, that acetic acid is a compound of the radical carboxyl (half a molecule of oxalic acid) and the radical methyl (half a molecule of methyl gas), that trichloracetic acid similarly contains the same radical carboxyl and the radical CCl_3, and that the prominent chemical properties of these bodies depend upon their containing carboxyl, and that they therefore resemble each other?

The modern view contains nothing inconsistent with that of Berzelius, but it no doubt contains something more,—it contains an explanation of the difference between the manner in which carboxyl is united to methyl in acetic acid, and the manner in which oxalic acid is united to bases in the oxalates; but it will surely be admitted that Berzelius was here far ahead of his opponents, —so far ahead that they altogether failed to see his meaning, and looked upon his argument as a clumsy device.

The treatment by Berzelius of the constitution of the sulpho-acids furnishes a precisely similar case. These are now considered as compounds of the radical SO_2OH (which we may call sulphoxyl). This radical is half a molecule of hyposulphuric acid, and Berzelius considered them as coupled compounds of hyposulphuric acid, adopting at once the view first brought forward by Kolbe, in his classical memoir on the sulphite of perchloride of carbon, and the acids derived from it.

I might pursue the history of the carbon- and sulpho-acids further, and trace the development of the theory of their constitution through the discoveries of Kolbe and his beautiful application to the cases of carbon and sulphur of Frankland's far-sighted speculation on the constitution of the organo-metallic bodies,—pointing out the relation of Kolbe's views of the constitution of acids, alcohols, aldehydes, and ketones, to the Berzelian theory on the one hand, and to the opinions of modern chemists on the other; but the greater part of such a historical sketch has been given very recently by Kolbe himself, in the *Journal fur Praktische Chemie*, and I may therefore omit it.

It would be easy to bring forward cases to show that our present views can be directly derived from the substitution theory and the types of Dumas and Gerhardt, through the complications of multiple and mixed types and the labyrinthine formulæ to which these gave rise, to the wonderfully simple and comprehensive system of Kekulé; but that is unnecessary, as this development has been fully and ably described by more than one thoroughly competent writer.

We have been discussing a case in which Berzelius was right in considering a compound of carbon, oxygen, and chlorine as composed of two parts—an oxide and a chloride of carbon. It is only just that we should take some notice of cases, at first sight similar, in which modern chemists would be inclined to think that he was wrong. This is the more necessary as an examination of these cases will enable us to see what was the really valuable contribution made to speculative chemistry by the substitution theory.

Compounds containing three elements were formulated in two different ways by Berzelius:—1. One of the elements was represented as combined with a radical composed of the other two,—as hydrocyanic acid, $H_2.C_2N_2$; ether, $C_4H_{10}.O$. 2. The ternary compound was represented as composed of two binary compounds having one element common,—as caustic potash, $KO.H_2O$; chromochloric acid, $2CrO_3.CrCl_6$.

Phosgene gas was at first formulated in the former of these ways as $CO.Cl_2$; but latterly he was forced in consistency to give up all radicals containing oxygen or other strongly electro-negative element,[*] and to write the formula of phosgene gas $CO_2.CCl_4$. Similarly, in every case where a positive element or radical is combined with two negative elements or radicals, he represented the compound as composed of two binary compounds. Thus—chloride of acetyl, $2C_4H_6O_3.C_4H_6Cl_6$, as a compound of acetic acid and the corresponding terchloride.

This was in perfect consistency with the mode in which ternary compounds containing one negative and two positive elements or radicals were formulated,—as caustic potash, $KO.H_2O$; sulphate of copper, $CuO.SO_3$, &c., but it lacks the practical justification which can be given for the formula $C_2H_6.C_2O_3$ for acetic acid. For phosgene acts readily on water, forming carbonic and hydrochloric acids, an action which does not take place with perchloride of carbon, and it is not easy to see why the latter substance should be more readily attacked by water when combined with carbonic acid than when free. This difference did not escape the attention of Berzelius, and led him to distinguish two modes of chemical union:—1. Where the constituents were held together by the electro-chemical force, and wholly or partially neutralised each other, as in the oxygen and sulphur salts; and 2. Where a so-called "copula" was attached by an unknown force to a substance without greatly modifying its chemical activity. The distinction seems arbitrary; but it was not, as is usually supposed, a mere artificial bulwark to protect the electro-chemical theory; it has a real and very important meaning—a meaning which the development of the substitution theory enables us to explain.

The phenomena of electrolysis, upon which the Berzelian system is based, bring forward into great prominence *one* of the chemical units, viz., the *equivalent*, and the pre-eminent position of oxygen as the most electronegative element made it most natural to select the atom of oxygen as the standard of equivalence, so that an equivalent of any element or radical was defined as that quantity of it which was equivalent to one atom of oxygen. Gay Lussac's law of gaseous volumes, which was adopted by Berzelius, and which, by a curious accident, happens to be true for all elements gaseous at ordinary temperatures, led to the formulæ H_2 and Cl_2 for the equivalents of hydrogen and chlorine; but although these formulæ explicitly indicate the divisibility of the equivalents of these elements, this divisibility was not recognised, and integral numbers of equivalents were alone tolerated. Thus hydrochloric acid was written H_2Cl_2, ammonia N_2H_6, &c., and the etymological meaning of the word "atom" was soon lost. The use of barred letters, to indicate two atoms, or one equivalent of such elements as hydrogen and chlorine, further contributed to hide the important fact of their divisibility.

The first great result of the substitution theory was to change the unit of equivalence, and to take as the standard the atom of hydrogen or of chlorine, instead of that of oxygen; and although it would be most unjust to forget the services of Dumas, Gerhardt, and Laurent, in this matter, the credit of removing the bars from H, Cl, and their comrades, and allowing the hitherto chained partners to walk at liberty, undoubtedly belongs mainly to our distinguished colleague and master, Professor Williamson.

The establishment of the water-type, or, to put it in another form, the proof that the atom of oxygen contains two units of oxygen, inseparably united but capable of separate action, led the way to the explanation of all the difficulties which beset the theory of radicals and copulæ. It at once explained how two oxides or two sulphides unite together,[*] and the idea of "polybasic," or as we should now say polyad, atoms and radicals was soon used to explain the existence of polybasic acids, double salts, acichlorides, and many other kinds of ternary compounds.

But a fact does not cease to exist because it is explained. Quick-lime and water unite together, although we can now explain how they do so, and a useful purpose may still be served by the enumeration, as in the old dualistic formulæ, of the pairs of united equivalents. Although some of these equivalents belong to the same atoms, it is nevertheless true that they are united in pairs. Caustic potash might, then, be formulated $KO_{\frac{1}{2}},HO_{\frac{1}{2}}$, or $\frac{1}{2}(K_2O,H_2O)$; phosgene gas, $\frac{1}{2}(CO_2,CCl_4)$; and chlorochromic acid, $\frac{1}{2}(2CrO_3,CrCl_6)$. These formulæ are not so well suited for general use as those now current, but the consideration of them as accurate representations of facts may enable us to see that the copulæ of Berzelius had a real and valuable meaning. Take, for instance, the formula of acetic acid—

$$H_3C—CO—OH,$$

or $\frac{3}{4}CH_4,\frac{3}{8}CO_2,\frac{1}{2}H_2O,\frac{1}{2}C_2$. It is this last term which indicates the coupled character of the compound. If we look upon acetic acid as a compound of carbon, it is a coupled compound, because all the equivalents of carbon in it do not belong to the same atom, and the two atoms of carbon are directly united together, and replacement of the equivalents united to one of these atoms does not very greatly affect the function or chemical character of the equivalents united to the other.

I have, perhaps, spent too much of your time upon these historical questions. Let us now shortly consider what is the present state of our knowledge as to chemical constitution. This I have already defined as the order in which the constituents are united in the compound. We may indeed use metaphorical language, and speak of the relative position of atoms, perhaps deluding ourselves into the notion that such language is more than metaphorical, but the phenomena of combination and decomposition, although we cannot doubt that they depend solely upon the relative position and dynamical relations of the atoms, are not alone sufficient to prove even that atoms exist. Our knowledge of the intimate structure of matter comes from another source, from the study of the properties, rather than of the changes of substances, and of the transformations of energy which accompany the transformations of matter. This is strictly a branch of chemistry: the aim of chemistry is to connect the properties of substances and the changes they undergo with their composition, taking this word in its widest sense; and we must not allow our friends in Section A to cut our science in two, and appropriate the half of it. We all frankly admit that chemistry is a branch of physics, but it is so as a whole—no section of it is more purely physical than all the rest. To accept a narrower definition of chemistry is to reduce ourselves to the position which the collector occupies among naturalists, it is to admit that it is our business to provide part of the materials out of which a science in which we have no share may be constructed by others. But we need not fear that this so-called physical side of Chemistry will ever be divorced from the study of chemical change. The names of Faraday and Graham among those who have left us, of Andrews among those who are still at work, are sufficient proof of this, and a study of their researches will conclusively show that great results can be looked for in this direction only from a physicist who is also a chemist.

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[*] In 1838 Berzelius was inclined to regard C_2O_2, to which he gave the name "oxatyl," as the radical of oxalic acid and oxamide.

[*] It does not explain the existence of double chlorides, bromides, &c. These compounds, apparently so similar to the double oxides and sulphides, are still unexplained.

There are three special directions in which such investigations have already influenced chemical theory:—

1. *Electrolysis*, which has confirmed the equivalent as a chemical unit, has proved that equivalents unite in pairs —thus forming the basis of the electro-chemical theory, and has shown us how to estimate the amount of energy involved in the union of a given pair of equivalents.

2. *Vapour Density*, from which Avogadro inferred the law of molecular volumes (since proved by Clerk Maxwell), which has given us the molecule as a chemical unit, and formed the basis of the unitary theory.

3. *Specific Heat*, from which Dulong and Petit inferred their empirical law, which gives us the most satisfactory physical definition of the atom as a chemical unit.

We naturally turn to the future, and try to guess whence the next great revolution will come. For although periods of quiet have their use, as affording time for filling up the blank schedules furnished by the last speculative change, such periods have seldom been long, and each has been shorter than its predecessor.

But it is impossible to make a certain forecast. Looking back, we see a logical sequence in the history of chemical speculation, and no doubt the next step will appear, after it has been taken, to follow as naturally from the present position. One thing we can distinctly see—we are struggling towards a theory of Chemistry. Such a theory we do not possess. What we are sometimes pleased to dignify with that name is a collection of generalisations of various degrees of imperfection. We cannot attain to a real theory of chemistry until we are able to connect the science by some hypothesis with the general theory of dynamics. No attempt of this kind has hitherto been made, and it is difficult to see how any such attempt can be made until we know something in reference to the absolute size, mass, and shape of molecules and of atoms, the position of the atoms in the molecule, and the nature of the forces acting upon them. Whence can we look for such knowledge?

The phenomena of gaseous diffusion, of gaseous friction, and of the propagation of heat through gases have already given us an approximation to the size and mass of the molecules of gases. It is not unreasonable to suppose that a comparative study of the specific heat of gases and vapours may lead to some approximate knowledge as to the shapes of their molecules, and a comparison of such approximate results, with the chemical constitution of the substances, may lead to a hypothesis which will lay the foundation of a real theory of chemistry.

Chemistry will then become a branch of applied mathematics, but it will not cease to be an experimental science. Mathematics may enable us retrospectively to justify results obtained by experiment, may point out useful lines of research, and even sometimes predict entirely novel discoveries, but will not revolutionise our laboratories; mathematical will not replace chemical analysis.

We do not know when the change will take place, or whether it will be gradual or sudden, but no one who believes in the progress of human knowledge, and in the consistency of Nature, can doubt that ultimately the theory of chemistry, and of all other physical sciences, will be absorbed into the one theory of dynamics.

PROCEEDINGS OF SOCIETIES.

DUTCH SOCIETY OF SCIENCE AT HARLEM.

This Society held its 122nd general meeting on the 16th of May, under the presidency of G. F. van Tets. Since its last general meeting the Society has issued Nos. 3, 4, and 5, vol., viii, and Nos. 1 and 2, vol. ix., of the *Archives Neerlandaises des Sciences Exactes et Naturelles*, and parts 1 and 2 of the second volume of *Natuurkundige Verhandelingen*. The "Huyghens" medal for this year was awarded to Dr. Kekulé for his researches on the constitution of the carbon compounds.

Prizes are offered for the following questions; all papers to be sent in by Jan 1st, 1876:—

(1.) Exact researches on the solvent power of water, and of water charged with carbonic acid, upon gypsum, lime-stone, and dolomite, at different pressures and temperatures, and in case of the simultaneous presence of common salt, and of other salts extensively distributed in nature.

(2.) Similar researches on the solvent power of water, and water charged with carbonic acid upon silica, and the common natural silicates under the same circumstances.

(3.) New researches on the structure of the kidneys of mammiferous animals.

(4.) It appears to result from recent researches that the peptones of the different albumenoid matters are mixtures of substances partly known and partly unknown. Required a critical examination of these researches supplemented by personal investigations on the same question.

(5.) Exact determination, in Weber's unities, of the resistance of a column of mercury of a metre in height and of a square millimetre in section.

(6.) Improved experimental determination of the relations between the two kinds of experimental unities, the electro-magnetic and the electro-static.

(7.) New experiments on the influence of pressure upon chemical action.

To the following questions answers are required by Jan. 1st, 1875.

(1.) For ten kinds of glass, of known chemical position, required—the coefficients of expansion between 0° and 100°; the cœfficients of elasticity; the indices of refraction for at least ten points in the whole extent of the spectrum.

(2.) Does the coefficient of expansion of steel vary with the degree of its temper, and is it possible to establish empirical laws on the connection between these two elements?

(3.) Does experiment enable us to establish a connection between the diffusion of liquids through porous septa, and other phenomena, such as those of capillarity?

(4.) Determine the coefficient of expansion of at least three liquids of simple composition.

(5.) Researches on the origin of the organs of sensation in the lower animals.

(6.) What are, in terrestrial magnetism, the periods known with approximate accuracy, and is it possible to connect these periods with other phenomena, cosmic or terrestrial.

(7.) New experiments and observations on the formation and mutual displacement of albumenoid matters in plants, preceded by a historical conspectus and criticism of former researches on the same subject.

(8.) The density, coefficient of expansion, melting-point, boiling-point, specific heat, index of refraction, and specific rotatory power of at least 20 organic compounds of known chemical constitution, each pair of which must be isomeric.

(9.) An extension of the researches of Regnault on the specific heat of the terpenes, and those of Berthollet on diamylene and triamylene to the largest possible number of other compounds in order to determine whether the specific heat of the polymers of a compound is, as a general rule, equal to that of the fundamental body which gives rise to them.

(10.) Investigation into the constitution of tetraphenol and its derivatives.

(11.) Critical examination of observations and experiments on the presence of bacteria in the contagious maladies of man and other mammalians.

(12.) Examination of researches on the growth of bones.

(13.) Study of certain Linnæan species of plants with a view to determine the definition of a species.

THE PUBLIC ANALYSTS AND THE REPORT OF THE ADULTERATION OF FOOD COMMITTEE.

In commenting on this subject we remarked that the Public Analysts "to a man" rejected the proposals for a reference to Somerset House, and for a preliminary examination at South Kensington. This statement, we learn, has been challenged on the ground that one gentleman signified himself willing to accept the appeal to the Inland Revenue chemists. We still, however, adhere to our declaration, as the gentleman in question is not a Public Analyst under the Act, and was, consequently, no more entitled than ourselves to fill up the preliminary circular. We have also been asked why the Parliamentary Committee, in seeking for a board of referees and examiners, overlooked the claims of another establishment which enjoys Royal patronage—to wit, the Polytechnic College. We presume it was simply *fortune de la guerre* which gave the preference to Somerset House and South Kensington.

We have heard the complaint that to accept a board of referees elected by the Public Analysts would be allowing them to elect their own judges. We do not see the force of the objection. Every analyst who believes his own results correct will naturally wish that, if revised at all, they should be submitted to the ablest and most experienced men in the country. Even if the analysts may be considered as to some extent interested parties, that does not, according to the general custom of the country, disqualify them from selecting their own referees. Look, for instance, at the composition of the Parliamentary Committee. To a large extent it comprised gentlemen connected with the very trades whose doings were called in question. Were not the tea trade, the vinegar and mustard manufacture, the "corn-flour" business represented? Was not the chairman himself, Mr. Sewell Read, a farmer, and thus, indirectly at least, interested in the milk trade? Ill would it become such a Committee, or the Administration which appointed them, to object to the claim of the Public Analysts to select as referees a body of chemists in whom they have full confidence, and to whose award, in case of dispute, they would be prepared to submit.

Turning to questions of detail, we cannot help admitting that the taking of samples is involved in some difficulty. That an inspector, on tendering payment, should have an absolute right to obtain samples of any substance offered for sale is self-evident. But what about the transmission of samples, and about the right of the shopkeeper to have an identified sample to send for analysis to any chemist he or his legal adviser may select? It was proposed that the inspector should have the power, if required, of sealing up a second sample at the same time, and leaving it with the suspected tradesman. To this it was objected that the inspector might be bribed to lend the shopkeeper his seal, and that the latter might make up a pure sample, and forward it for examination; thus not only escaping from all penalties, but ruining the professional standing of the Public Analyst. But, without at all sanctioning the imputation that the inspectors are open to bribery, let us ask whether a seal is really any guarantee for the identity of the sample. Let us suppose that Inspector A calls upon B, grocer and tea dealer, and obtains a pound of ground coffee, sold as pure, but suspected of being chicoried. He makes up this sample, in presence of B, into two parcels, which he secures with his official seal. One of these he takes with him and formally delivers to C, the Borough Analyst. The other he leaves with the grocer. What is to hinder the latter from taking an impression of the seal with the crumb of bread, and then melting it, open, removing the contents, and replacing them with pure coffee? He then re-closes the parcel, softens the wax, applies his forged seal, and dispatches the whole to any chemist he thinks proper. When the case comes to trial the Inspector will be obliged to admit that the sample analysed on behalf of the defence bears his seal and any private marks which he has made for better identification. We suggest that the check-sample should be left in the custody of some public official who is above suspicion, and should be sent to any chemist whom the defendant may select, through the medium of the post-office, without ever being placed in the hands of any person interested either in the prosecution or the defence.

The important suggestion was made that, as concerns articles sold avowedly as mixtures, such as coffee with chicory, mustard with flour, &c., it should be obligatory upon the seller to declare not merely the bare fact of the admixture, but its amount. This proposal meets with our warmest approval. An article may be sold, under the law as at present existing, as a mixture of coffee and chicory, but whether the chicory forms 10, or 40, or 70 per cent, the purchaser has no means of ascertaining. Nor could the seller be legally convicted if even 1 per cent of coffee were present. The "declaration of admixture" requires also some amendment. It should be printed on the package in a prominent manner, and on a place which will be visible when it is closed up. One of the Public Analysts present at the recent meeting mentioned a case where the notice was placed on the inside of the package.

We shall await with interest the conclusions of the Committee appointed by the Public Analysts to consider the above and a variety of other important points.

CORRESPONDENCE.

SUSPENSION OF CLAY IN WATER.

To the Editor of the Chemical News.

Sir,—I have read with much interest the paper by Mr. Durham on the above subject in the Chemical News, vol. xxx., p. 57, and shall feel obliged if you permit me to draw attention to the following extract from a memoir by Dr. Sterry Hunt, which he read, on February 18, before the Society of Natural History, Boston, U.S.

"Having examined the water of the Mississippi near its mouth, he found it to contain about 1-2000th of suspended matter, chiefly clay, which required from ten to fourteen days to subside. He, however, observed that the addition of sea-water or of salt, sulphate of magnesia, alum, or sulphuric acid, rendered the turbid water clear in from twelve to eighteen hours. He thus explained the ready precipitation of the suspended clay when the river water comes in contact with the salt waters of the Gulf of Mexico, causing thus great deposits of fine mud, and helping us to understand the origin of the accumulations of argilites and clay slates which are met with in various geological formations. An explanation of this phenomenon is to be found, Dr. Hunt thinks, in the researches of Guthrie on the formation of drops (*Proc. Roy. Soc.*, xiv., 1864). Studying the size of drops of water falling from a small sphere of ivory, he found that the cohesion of the water was diminished when it held saline matter in solution, as was shown by the smaller size of the drops. This was verified by experiments with solutions of various strengths of nitre and chloride of calcium. It was found that the addition of 8 parts of the latter salt to 1000 parts of water reduced by one-ninth the size of the drops, which was determined by their diminished weight. These results show a diminished cohesion of the liquid to the ivory sphere, from which it was by the force of gravity made to fall. The cohesion, in virtue of which extremely attenuated particles of clay are held in suspension in water in opposition to gravity, is in this manner so far reduced by the addition of saline matters that gravity and cohesion rapidly assert themselves among the suspended particles, which collect together and subside, leaving the saline liquid clear. The precipitation of suspended clay is made very rapid when a strong solution of salt is employed."

It will be noticed that Dr. Hunt's observations are almost the same as those given by Mr. Durham.

Their interpretation of the phenomena, however, is different; but as Mr. Durham hopes shortly to put his idea to the test of experiment, those interested in the matter will await his further inquiries.—I am, &c.,

T. R. O.

Greenock, August 10, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, No. 26, June 29, 1874.

New Property of Metallic Rhodium.—MM. H. Sainte-Claire Deville and H. Debray.—The authors found long ago, on employing zinc as solvent of the platinum metals, that the pulverulent and metallic matters obtained after the separation of zinc by acids had singular properties, which they have carefully studied. When rhodium and iridium are thrown down from their solutions by formic acid or by alcohol, the finely-divided metallic powders have properties which are briefly mentioned to claim priority. Rhodium, in the state in question, decomposes formic acid with evolution of heat, reducing it to hydrogen and carbonic acid. At a slightly higher temperature pulverulent rhodium transforms alcohol in contact with alkalies, hydrogen being given off, and an alkaline acetate formed, even in very dilute liquids. When the action of rhodium upon formic acid becomes enfeebled, it is merely necessary to wash the metal, and dry it in contact with the air, to restore it to its full efficacy. Platinum and palladium, prepared in a similar manner, have no effect upon formic acid, whilst iridium and ruthenium act like rhodium.

Theory of the Shock of Bodies, taking the Atomic Vibrations into account.—M. A. Ledieu.—Conclusion of the paper begun in the *Comptes Rendus* for June 22. The author considers the use of the general relations obtained in the preceding part of this paper for the solution of questions on the shock of bodies occurring in industrial mechanics; general expression of the loss or gain of *vis viva* for the whole of a body struck between any two instants of the collision, and the true expression of Carnot's theorem; different cases of equality between the total *vis viva*, whether real or of the entire mass, before and after the shock; and, lastly, observations on the determination of the mechanical equivalent of heat by crushing lead.

Spectra of Vapours at Elevated Temperatures.—J. N. Lockyer.—Mr. Lockyer's communications relate to the molecular structure of vapours, considered with regard to their densities, and the manifestation of the modifications produced in the structure of the molecules. The general results are that if we consider like spectra as indicative of like molecular condition it must be said that the vapours whose densities have been determined cannot have been in the same molecular conditions.

Report on the State of the Preparations for the Expeditions Arranged by the Academy to Observe the Transit of Venus, December 9, 1874.

Report on the Measures to be taken against the Phylloxera.—The steps recommended are—Owners of vineyards compelled to declare the appearance of the phylloxera; appointment of experts by the prefects to examine the existence of the evil, and estimate the amount of damage. Destruction of the infested vines when thought necessary to hinder the spread of the disease. Compensation to the proprietors in such cases. Chemical disinfection of the soil, and destruction of all roots, stems, leaves, &c., of the vines by fire. The same ground not to be re-planted with vines until some other crop has been grown upon it.

Temperature of the Sun.—M. J. Violle.—The author describes his apparatus and methods, and concludes that the temperature of the sun at Grenoble, on June 20, at 3.30 p.m., was 1354°.

Concerning the above researches of M. Violle, H. Sainte-Claire Deville remarks that it is not prudent to speak of temperatures above those which have been measured, the highest of which probably has been determined by the experiments of Bunsen. In speaking of calorific phenomena produced by combination we must remember that, in given conditions of temperature and pressure, the quantities of matter which combine, and consequently the amounts of heat produced, are limited by the phenomenon of constant dissociation—a limit which the speaker's experiments place very near to measurable temperatures. It is, therefore, not permissible, until the contrary has been demonstrated, to speak of those fabulous temperatures which have often been mentioned.

On High Temperatures.—M. Berthelot.—The author remarks that the existence of high temperatures as a general principle, and the possibility of realising them, must be carefully distinguished. Our present theories indicate that a given gaseous mass may acquire a *vis viva* indefinitely increasing—that is to say, an unlimited temperature, at least as far as simple gases are concerned, and as long as we do not throw any doubt upon the absolute character of the laws of Mariotte and Gay-Lussac. With this reservation there would be no other limit conceivable than that which would correspond to the destruction of our present elements, and their resolution either into simpler elements, or into an universal ethereal matter. But, in fact, it may be that the intensity of the radiations of every kind, augmenting with extreme rapidity as the temperature rises, and consequently the loss of *vis viva* which communicates itself to the surrounding media, becomes more and more considerable. Thus the realisation of every temperature exceeding the limit bordering on 2500° or 3000°, observed in the experiments of Sainte-Claire Deville, is rendered impracticable.

Application of Bisulphide of Carbon, mixed with Tar and Alkalies, for the Destruction of the Phylloxera.—In this combination the use of this agent produces no danger, either to the operator or to the vine.

Telluric Theory of the Dissemination of Cholera.—Dr. Decaisne.—The author explains the local distribution of cholera on geological principles, and ascribes the immunity of Lyon to the fact of its resting on granite.

New Method of Determining the Index of Refraction of Liquids.—MM. Terquem and Trannin.—The apparatus which the authors propose would scarcely be intelligible without the aid of a diagram. The results which the authors obtain by their method agree closely with those found by Fraünhofer, Dale, and Gladstone.

Electro-Static Phenomena in Batteries.—Alfred Angot.—The author concludes that an isolated battery has the same electric capacity as a conductor of the same dimensions.

Evaporation of Liquids at Temperatures Higher than the Boiling-Point.—M. D. Gernez.—The law of Dalton does not apply rigorously to the evaporation of superheated liquids, but it may be regarded as giving results approximating to those furnished by experience.

Phosphorescence of Phosphorus, Sulphur, and Arsenic.—M. Joubert.—The phosphorescence of phosphorus takes place neither in a perfect Torricellian vacuum, nor in a gaseous atmosphere free from oxygen. If the latter gas is perfectly excluded, phosphorus may be melted and distilled without the least phosphorescence. The total pressure of the mixture, which puts an end to the luminous appearance, is so much the greater as the proportion of oxygen is lower. Sulphur and arsenic possess exactly the same properties. Sulphur becomes luminous at about 200°, and arsenic at a somewhat higher temperature. In each case the presence of oxygen is essential, and the pressure of this gas must be within determined limits.

New Apparatus, called Accelerometers, for Observing the Phenomena of the Combustion of Powder.—MM. Deprez and H. Sebert.—The results of the experiments are given in tables not suitable for insertion.

Intestinal Calculus of the Sturgeon.—MM. Delachanal and Mermet.—The calculus contained lithia in notable amount, capable of quantitative determination, a circumstance of interest, as bearing upon the composition of the waters of the Caspian and of its affluents.

Results Obtained with the Use of Phenic Acid in Inhumations.—M. Prat.—Four bodies were placed in sawdust saturated with phenic acid, exposed to the air in this state for two months, and were then buried. They were afterwards exhumed, the one after the lapse of two years, and the three others after five years. The author found on examination that the phenic acid had greatly modified the course of putrefaction. Decomposition remained stationary as long as the phenic acid was able to act, but when it disappeared, by evaporation or other causes, the putrefaction resumed its course with much greater rapidity, and the bodies were converted into adipocire.

Presence of Lead in the Brain.—M. Daremberg.—With reference to the case stated by MM. Bergeron and l'Hote (*Comptes Rendus*, June 15, 1874), it may be mentioned that in cases of chronic lead-poisoning that metal has been detected in the brain.

Moniteur Scientifique, du Dr. Quesneville, July, 1874.

New Fulminate with a Base of Picrate of Lead.—M. Prat.—Picrate of lead has the property of detonating when struck, and—according to the author—may serve as a substitute for fulminate of mercury in percussion caps. He also gives an account of an explosion which occurred in his laboratory on triturating together chlorate of potash, picrate of lead, and amorphous phosphorus.

Fixation of Mordants of Iron and Alumina.—E. Schultz.

Dyeing with Artificial Alizarin along with Mordants of Iron and Alumina.—A. Schultz.—These two long and valuable papers do not admit of abstraction.

Report on the Alteration, the Corruption, and the Purification of Rivers.—A. Gérardin.—The author maintains that the only means of ascertaining the purity of water is to observe whether animal and vegetable life can be supported in it. If all organic beings, except infusoria and cryptogamous plants are destroyed, the water is infected. The fish which inhabit a river guarantee it.

MISCELLANEOUS.

Programm der Königlichen Rheinisch-Westfälischen Polytechnischen Schule zu Aachen.—A prospectus of one of the admirably constituted schools of practical science to which Germany owes no small part of its rapid industrial progress. In those departments in which we are more especially interested, we find that this establishment has a professorship of pure chemistry, held at present by Dr. Landolt, with two assistants; a professorship of technical chemistry, with two assistants; a professorship of mineralogy; and one of physics. There is a laboratory for pure chemistry, with a museum of specimens; a laboratory for applied chemistry, with a technological and metallurgical museum, a mineralogical and palæontological museum, and a sanitary and anthropological museum. The students have especial practice in arranging and planning chemical manufactories of various kinds, and thus, if they obtain in after life an appointment at any chemical works, they possess at the very outset a full acquaintance with the whole plant, buildings, and machinery. This department is, to the best of our knowledge, sadly neglected in the education of practical chemists in England. Will the new Yorkshire College of Science follow this example? There is another point which deserves particular notice. All the professorships at Aachen, and we believe at all similar establishments in Germany, are evidently held by natural-born subjects of the German Empire. The German educational authorities are aware of the necessity of training up talent and research at home, instead of importing it from abroad; they know that nothing is more discouraging to students than to see honourable positions given to foreigners rather than to natives. There are at Aachen separate faculties or courses of study for architects, engineers, geodesists, mechanicians, chemists, and metallurgists. This separation of the different departments is a characteristic, and, in our opinion, a most valuable, feature of all establishments for higher education in Germany. The Germans attach very little value to the views of a man on any question except he is "ein Mann vom fach,"—a specialist who has devoted himself to that particular subject. In this country we unfortunately believe that a man of general education is qualified to give an authoritative deliverance on any subject; hence we allow our students to spend the bulk of their time at college in studies having no special bearing on their ultimate destination, fondly hoping that they can "pick up" afterwards those sciences on which their reputation, their success in life, and their usefulness to the public are to depend. The annual fees for students at the Aachen Polytechnic do not at the utmost exceed six guineas! Let this be compared with the scale of charges at our School of Mines. How often must we be warned of the necessity of altering our educational plans if we would maintain our industrial position?

NOTES AND QUERIES.

Manufacture of Bichromate.—Can any of your readers inform me of a ready method of ascertaining the amount of decomposition of chrome ore in a charge while being furnaced in the manufacture of bichromate?—Ria.

Solution of Sulphur in Carbonate of Potassium.—I have recently had occasion to notice the following remarkable reaction, of which I can find no mention in the various authorities which I have consulted:—I added sulphur (in the form of "flowers") to a boiling solution of K_2CO_3, in which it was rapidly and completely dissolved, with evolution of H_2S and CO_2, to a clear solution of a rich orange colour, which on cooling changed gradually to pale yellow. A portion of this solution I reserved for examination: the remainder I evaporated to dryness over the water-bath, an operation attended throughout with the disengagement of H_2S. The resulting residue was of a yellow colour, and extremely deliquescent; re-dissolved in distilled water, it was found to be characterised by the following reactions, which are identical with those obtained with the original solution:—1. HCl caused an immediate separation of S, attended with slight effervescence due to excess of K_2CO_3. 2. $FeSO_4$ (solution) gave a black precipitate of FeS. 3. $AgNO_3$, a mixed precipitate—part of which was orange-brown, and part black, the whole soon assuming a uniformly black appearance. From these and other reactions I infer (1) the presence of potassic sulphide and hyposulphite, and of H_2S both free and combined, and (2) that the H_2O of solution, being the only possible source of H, has been decomposed to furnish H_2S; and, therefore, that the whole reaction may be fairly summed up in the following equations:—

$$(1).\ 3(K_2CO_3) + S_{12} = \overbrace{2K_2S_5}^{\text{Potassic pentasulph.}} + \overbrace{K_2S_2O_3}^{\text{Potassic hyposulph.}} + 3CO_2$$

$$(2).\ K_2S_5 + 3H_2O = K_2S_2O_3 + 3H_2S$$

These are but tentative, and I am still doubtful on two points—(1) As to whether KHS is formed or not; and (2) as to how so much H_2S comes to be evolved in presence of K_2CO_3. I shall be glad to learn if this is a new reaction; if not, by whom and where it has been before published.—Chas. Cross.

TO CORRESPONDENTS.

⁂ The Students' Number of the Chemical News will be published on Friday, September 11. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, will confer a favour by sending us the necessary information for publication in that number.

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THE CHEMICAL NEWS.

Vol. XXX. No. 770.

THE COMPOSITION OF THE FIBRE OF THE JUTE PLANT, AND ITS USE AS A TEXTILE MATERIAL.*

By Professor HODGES, M.D., F.C.S.

At the Meeting of the Association held in this College twenty-two years ago, I had the honour of reading before this Section a report on the composition of the flax plant, the fibre of which supplies the raw material of the staple industry of this part of Ireland. In that and subsequent reports I gave an account of a series of investigations which had been undertaken by me at the request of the Association, and in which the composition of the fibre, and the changes which it undergoes in its technical preparation, were for the first time completely examined. The interest which these reports excited in this great centre of the linen industry has encouraged me to submit to the Section some account of the history and chemical composition of another textile material, which at the time of our former Meeting was scarcely known in this country, but which has lately assumed a most important place among the vegetable substances employed by manufacturers. Fifty years ago the fibre of the jute plant was to be found only in our museums; now the quantity of it introduced into the United Kingdom almost equals that of the flax which we import, and exceeds the annual importation of hemp, and, owing to the improvements which have been effected in the processes for its preparation, and especially in the methods of bleaching, it is, I believe, destined to occupy in future a more important place among the raw material of our textile manufactures. The plant which yields the fibre known in commerce as "jute," a name which is supposed to be derived from a corruption of the Bengali name of the plant, is a member of the family *Tiliaceæ*, the linden or lime-tree family, which from remote periods has been cultivated by the natives of Southern Asia for textile purposes. Two species of it are used for the production of fibre, *Corchorus Capsularis* and *Corchorus olitorius*, and both kinds are found in the jute brought to this country. The *Corchorus* is an annual, the seeds of which are sown broadcast in the months of March and April, on ploughed land along the sandy banks of rivers, usually neither irrigation nor manure being required. In August, before the seeds, which replace the small yellow flowers of the plant, have ripened, and when the stems have attained the height of about 12 feet, the crop is cut; when the seed is allowed to become fully ripe, as is also the case with flax, the fibre becomes stiff and hard, and the stem is rendered of a reddish colour. The stalks, when cut, are tied in bundles and placed in tanks, usually of dirty water, and allowed to ferment, or "ret," for five or six days, and then taken out and swung about repeatedly in the air, by which the long fibres are separated from the brittle wood which constituted the bark of the stem, and, thus prepared, the fibres are dried by exposure on the ground to the air, and, when dry, packed in round bundles for the market. The treatment of the plant for the separation of the fibre is therefore precisely like the ordinary methods used by farmers in this country in the preparation of the flax fibre. The produce of jute far exceeds that of flax, being, it is stated, five times as great as that which flax affords. Though India is the great seat of jute cultivation, and supplies the fibre used in this country, yet the jute plants, especially *Corchorus olitorius*, have been long cultivated in China and other Eastern countries. Experiments have been made to grow the plants for textile purposes in the Southern States of America, on the banks of the Lower Mississippi, and also in Algiers, and it is said the results are encouraging.

A large portion of the jute grown in India is used in making sacks, which, under the name of *gunny* bags, are sent in great numbers to America to be used for packing cotton. Dr. Royle states that textures from other Indian plants, as well as from the jute, are used for the manufacture of these bags, among others the fibres of the *Crotolaria juncea*, the Bengali name of which, *goni*, is supposed to be the origin of the term "gunny" applied to the bags. In the monthly reports of the Department of Agriculture of the United States of America, it is stated there were lately in the States two-hundred looms working jute, and that their existence depended entirely upon the imported gunny cloth.

For some time after the introduction of jute, the opinion prevailed that it could not be bleached, and was therefore of little value as a textile material. Experiments made at several times proved that this was a mistake, but until lately scarcely any progress had been made in improving the qualities of the fibre, or giving it the whiteness of linen fabrics. The difficulties, however, which retarded the success of jute bleaching have during the present year been completely removed, by the application of methods which have been patented by my son, and which are at present in operation at works erected for the purpose by Mr. W. Sibbald Johnston, of this town, at Mile-Cross, near Newtownards, in the neighbouring county of Down. In the processes employed, the cloth or yarn, by means of ingeniously arranged machinery is made to pass in succession through baths of alkaline solutions and hypochlorites of magnesia and soda, the magnesia used being economically obtained from kieserite, which is found in large quantities in Germany in the kainite deposits, and has hitherto been regarded as of but little commercial value.

The length of the fibre of the jute of commerce is frequently no less than 12 feet; usually the lower end near the ground is dark-coloured and woody. At first the fibre is colourless or only slightly coloured, but some kinds after a time become darker, just as wood darkens in colour by the action of the air. Many specimens preserve a dull yellowish colour, and in appearance can with difficulty be distinguished from the finer qualities of hemp. The microscope, however, shows us that the structure of the jute is different from that of any of our common textile fibres; thus, while a fibre stripped from the flax plant is shown to consist of bundles of cells with thick walls and somewhat circular outline, and exhibiting a very minute central space, the wall of the jute cell is of very irregular thickness, and the central space does not conform to the external outline, but at one part will be found wide, while at another part it dwindles to a mere line. By this remarkable difference in the contour of the inner and outer cell walls, jute fibre is distinguished from flax, hemp, cotton, and New Zealand flax. The application of the sulphate of aniline proposed as a reagent for woody matter by Runge, and recommended by Professor Wiesner, of Vienna, also affords us assistance in distinguishing it from both hemp and flax fibres. Thus, while hemp is scarcely at all affected by this action of the reagent, and flax unchanged in colour, the jute fibre shows that it contains a large amount of woody matter by becoming of a deep golden-yellow colour. The sulphate, however, does not enable us to distinguish jute from several other Indian fibres.

In connection with the technical preparation, bleaching, &c., of the jute fibre, I lately commenced a series of investigations which, though not so far advanced as I had hoped, may not be destitute of interest. The samples of fibres which I submitted to examination were kindly supplied to me by Mr. Sibbald Johnston, proprietor of the Kiltonga Bleach-Works, and were of the kind known as "Red Seraigunge." The fibre had a faint red colour, and measured in length 10 feet 9 inches. It had been prepared in the ordinary manner, and of course contained only those constituents of the plant which remained attached to the cellular structures after being submitted to the process of retting. Portions of the fibre cut into small pieces, after being treated with distilled water, and boiled for several hours, gave an acid solution, of the colour of pale ale, which evolved an odour which suggested the aromatic smell of moist flax yarn. On evaporation over the water-bath, it left a brownish black extract, which in appearance resembled black-currant jelly; it was translucent at the edges, and was easily reduced to a light brown powder. This extract amounted to only 0·726 per cent of the fibre, and was found to contain sugar and a tannic acid which gave an olive-green precipitate with per-salts of iron, a fatty substance, and a brown-red colouring matter. The extract was in part soluble in alcohol, and heated on platinum it carbonised without melting, leaving a white ash. It contained no starch. The fibre employed, dried at 212°, was found to contain 15·5 per cent of moisture, and, when incinerated, to leave 1·329 per cent of ash, of a pale yellowish white colour; treated by the successive action of solvents, according to the methods described in my reports on flax, and the amount of nitrogen determined by Wills's method, both in the original samples and in the fibre after the action of the solvents, the results obtained were as follows:—

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* Read before the British Association, Belfast Meeting, Section B.

100 parts yield—

Moisture	15·540
Organic matter	83·131
Mineral matters	1·329
	100·000

(See reports of the British Association for 1852 and 1853).

100 parts of the fibre, dried at 212°, yield—

Wax and fatty matters soluble in ether	0·235
Tannic acid and colouring matters soluble in alcohol	1·135
Sugar, pectine, &c.	2·427
Soluble nitrogenised matters	0·512
Insoluble nitrogenised matters	2·433
Inorganic matters united with the fibre	1·010
Cellular fibre	92·248
	100·000
Nitrogen in the original fibre	0·291
Nitrogen in the fibre after treatment with solvents	0·210

I had hoped to be able to give an analysis of the jute plant in the condition in which it is removed from the field, but unfortuately a specimen which had been forwarded from Calcutta arrived only a few days ago, and I must therefore defer its investigation until some other opportunity. With respect to the magnitude of the jute manufacture, I may state that in the present year 100,000 tons of the fibre were imported into Dundee alone by direct shipment from Calcutta, while London, Liverpool, and Glasgow received probably half as much more. The rapidity with which, by means of improved machinery, it can be manufactured may be judged from the fact that, since the opening of the Suez Canal, the fibre has been delivered in Dundee, spun and woven, and the goods shipped back, and paid for, viz., within six months from the date of the bill of lading. At the present time jute is used for the manufacture of a great variety of fabrics; in fact, it will serve for the production of every kind of coarse textile material. It is even used as a substitute for hair, and can be formed into admirable chignons. The dust from the mills is employed to make silk hats, and the waste fibre yields an excellent pulp for the manufacture. Stair-carpets of jute, with bright colours, can be sold at 3d. per yard, and, woven into what are known as carpet bed-covers, a fabric is produced at not more than one-third the price of wool.

ON THE
PETRIFIED WOOD OF LOUGH NEAGH.*

By Professor HODGES, M.D., F.C.S.

The occurrence along the shores of Lough Neagh, in this province, of masses of petrified wood has, from very early times, attracted attention, and many ancient writers, amongst others, Boetius, in his history of stones and gems, and several modern authorities, have ascribed to the waters of this lake remarkable petrifying qualities. In fact, popular opinion has so generally attributed these properties to them, that in a report some years ago made to the Water Commissioners by an English engineer of high reputation, on the water supply of this town, we find the water of the lake described as totally unfit for use, "as from its well-known property of coating wood and other matters immersed in it, it is unquestionably hard."

Bischof, in his "Chemical Geology," also refers to the property of the water of petrifying wood placed in it, or rather causing its impregnation with iron, which induced him, he says, to make a chemical analysis of it. He, however, merely examined the insoluble portion of the matters left on evaporating the water, and found, contrary to what he had expected, that there was an extraordinary small quantity of earthy constituents. From the suspended matter, by means of hydrochloric acid, he extracted iron and alumina, but in too small a quantity to admit of estimation. The fact that peroxide of iron, he remarks, is the chief constituent of the suspended matter, is in accordance with the statement in the *Philosophical Transactions*, that the lapidifying substance is iron, and that when the petrification is only partial upon burning such a wood, only the petrified part comes to a glow heat, and the ash which is left is attracted by the magnet. Bischof also made a partial examination of a specimen of the petrified wood, which, however, does not sustain his views respecting the ferruginous nature of the lapidifying material, as he found it to contain only 0·54 per cent of oxide of iron and alumina; so he expresses the opinion that the petrified wood had certainly not been lapidified by the water of the lake, but resembled the silicified wood occurring in the brown coal formations.

The specimen of petrefied wood examined by Bischof gave the following results:—

Silica	97·71
Oxide of iron and alumina	0·53
Loss on ignition	0·54
Loss and organic matter	1·22
	100·00

On ignition, only a feeble empyreumatic odour was perceptible and a slight darkening in colour.

The popular notion respecting the properties of the water of this lake are even at the present time entertained by many persons of education, and the opinion which in early times prevailed, that when a piece of wood is fixed in the water along the shores of the lake, in the course of seven years the part immersed in the water is changed into stone, while the part in contact with the muddy bottom is transformed into iron, the portion of the wood exposed to air remaining unchanged, has not entirely passed away.

Immense masses of the petrified wood have been found along the shores of the lake, and the Rev. Dr. M'Closkie, in an excellent paper read some time ago before our local Natural History and Philosophical Society, has given an account of the numerous localities, not merely on the drift deposits along the lake, but a considerable distance inland, in which specimens have been discovered. Some of the pieces of wood discovered are of large size, and one mass described by Dr. Barton, in his "Lectures on Natural Philosophy," &c., published in Dublin in 1751, weighed so much as 700 lbs.; and there is at present, or was lately, at Langford Lodge, near Crumlin, in this county, a silicified trunk, 10 feet long, and about the same in circumference. The specimens discovered vary very much in hardness and in colour; when associated with lignites they are easily split and dark coloured, but when occurring as boulders in the drift they are bleached on the surface white; the interior is black or dark brown. On the surface of some of the specimens minute crystals of quartz are found. The woody structure of the petrifactions is in general well marked, and microscopic examination shows it to be that of coniferous trees. By Kraus, it has been named *Cupress oxylon Pritchardi*, which, among living Coniferæ, is represented by Cupressaceæ and Podocarpeæ.

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* Read before the British Association, Belfast Meeting, Section B.

Having on several occasions submitted the water of Lough Neagh to chemical examination, and also made analyses of specimens of the silicified wood, a report of my results may be interesting to the section. These analyses show that in no part of the lake does the water contain any considerable amount of solid matter, and that neither in the water nor in the petrified wood is to be found more than a very minute quantity of iron. A specimen of the water which was kindly forwarded me last month by Mr. Turtle, of Aghalee, and which had been taken at Sandy Bay, 100 yards from the shore, and 4 miles from Glenavy river, near a part of the lake shore in which the petrified wood is frequently discovered, when received by me was slightly turbid from finely-divided flocculent matter, and colour, when viewed through a layer 2 feet in length, was pale greyish yellow. Its taste was soft, and a considerable number of animalculæ were moving about in it. It had an alkaline reaction.

On evaporation, it left a yellowish coloured residue which became black on ignition.

An imperial gallon contained 12·950 grains, consisting of—

Mineral and saline matters	10·826 grains.
Organic and volatile	2·124 „

The mineral matters were found to consist of—

Carbonate of lime	4·786
Carbonate of magnesia ..	0·496
Carbonate of soda	1·038
Sulphate of soda	1·711
Oxide of iron	0·727
Silicic acid	0·360
Chloride of sodium	1·704
	10·826

I also determined the amount of mineral matter contained in the water at two other portions of the lake. A specimen taken at the mouth of the river Bann, which, rising from springs in the granitic range of the mountains of Mourne, after a course of about thirty miles falls into Lough Neagh, and after passing through it issues as the Lower Bann at the north end of the lake, and serves, on its course to the sea, to divide the County of Antrim from the County of Londonderry, was found to yield 13·4 grains of solids, of which 10·6 grains consisted of mineral matters, while in another locality, about half a mile from the shore, the mineral matters were only 9·3 grains per gallon.

The water of the Upper Bann, except when it has been rendered impure by the numerous bleaching and other works on its banks, contains a very small amount of mineral matters. A gallon on one occasion I found to contain only 4·654 grains of mineral matters, consisting of—

Carbonate of lime	1·239
Sulphate of lime	1·353
Carbonate of magnesia ..	0·622
Oxide of iron	0·329
Silicic acid	0·205
Chloride of sodium	0·825
	4·654

A specimen of the petrified wood weighing 26 ounces, which the woody structure was clearly visible, and which was white on the outer surface and of a dark brown colour in the interior, when exposed to a strong heat in the crucible became black, and evolved an odour somewhat resembling that of burning wood, and, by continuing the heat, left a pale buff-coloured residue. Contrary to what is stated by some authorities, the wood was not affected by the magnet before or after ignition. In no specimen which I have examined have I found the ash magnetic.

100 parts of the specimen I found to yield as follows:—

Loss on ignition and organic matter	6·50
Alumina soluble in hydrochloric acid	0·68
Oxide of iron	0·04
Lime	0·29
Magnesia	0·25
Phosphoric acid	trace
Alumina in state of silicate	1·95
Lime	1·10
Magnesia	0·25
Silicic acid	89·01
	100·07

In another specimen from a different locality the loss on ignition was 9·1 per cent. It contained 84·5 per cent of silica, and only 1·5 per cent of oxide of iron and alumina.

The analyses therefore show that the water of Lough Neagh, in our time at least, possesses no peculiar qualities, and that the lapidifying material of the petrified wood is silicic acid, and not oxide of iron.

The examination of the specimens also clearly show that the hardening is not produced merely by superficial incrustation of the lapidifying silicic acid, but that it has penetrated through almost every portion of the vegetable structure.

ON NATIVE CUPREOUS SULPHARSENIATE.

By R. W. EMERSON MACIVOR.

A very good specimen of dufrenoysite from Switzerland having come into my possession, I resolved upon submitting it to a careful examination, with a view of removing the doubt existing as to the constitution of this mineral. The following is a description of some of the more important properties of the mineral, and its analysis:—It is crystallised in small mono-metric crystals of a dark grey, almost black, colour. Its specific gravity is 5·52. Before the blowpipe it exhales arsenical vapours, and fuses to a black mass. When exposed to the action of heat in an ignition-tube, it yields a sublimate composed of a mixture of arsenic trisulphide with uncombined sulphur. It is completely decomposed by nitro-hydrochloric acid. These numbers represent the results of the analysis of the specimen, neglecting small percentages of the sulphides of lead and iron—

Copper	46·05
Silver	2·43
Arsenic	18·79
Sulphur	32·46
	99·73

If the 2·43 per cent of silver be replaced by an equivalent proportion of monovalent copper, these numbers are found to agree very well with the theoretical percentage composition of normal cupreous sulpharseniate, $Cu_3(AsS_4)'''$—

	Found.	Calculated.
Copper	47·48	48·29
Arsenic	18·79	19·10
Sulphur	32·46	32·61
	98·73	100·00

The above results would seem to prove Stockar-Esher's view that cupreous sulpharseniate is dimorphous, as the mineral enargite has also the formula $Cu_3(AsS_4)'''$.

Glasgow, August, 1874.

NOTE ON THE ANALYSIS OF SUGAR.

By J. M. MILNE, Ph.D.

The determination of the fruit sugar in samples of raw sugars is a matter of no difficulty in the hands of a careful manipulator, but there are a few points in detail which are deserving of attention. The usual plan, still in use in some laboratories, of taking a weighed quantity of the sample, dissolving in water, and making up to a given bulk, and using the liquid so obtained for the determination of the fruit sugar, is by no means always to be relied on. There is no doubt, I think, that many dark-coloured sugars contain other substances (probably albuminous) besides the fruit sugar capable of reducing copper solution, and which must first be separated before correct results can be obtained. The method recommended by Fresenius, of adding lead acetate to the sugar solution till no further precipitate is formed, may be advantageously employed for this purpose. While in some samples the same amount of fruit sugar is found in the solution *before* precipitation with lead as that obtained *after* the addition of that reagent, in others the difference is very marked. The following results, obtained from a sample recently submitted to me for analysis, will illustrate this:—The sugar solution *without* treatment gave 4·90 per cent of fruit sugar, while in a measured quantity of the same solution *after* precipitation by lead acetate the amount found was 3·27 per cent.

The following method of procedure answers very well, and is employed by me for *all* sugar samples in which fruit sugar is to be determined:—5 grms. of the sample are dissolved in a moderate quantity of water, and the insoluble matter allowed to subside. The supernatant liquid is then carefully poured into a 100-c.c. flask, the insoluble treated with more hot water and finally collected on a small weighed filter, and the washing continued till the flask is about three-quarters full. To the sugar solution a little solution of tribasic acetate of lead is added, the whole well shaken, and the precipitate allowed to subside. The clear liquid is then tested with a drop or two of acetate, and, if no further precipitate is produced, the contents of the flask are cooled to the proper temperature, and finally made up to the mark with water, the whole being thoroughly mixed. When the precipitate has subsided, the liquid is passed through a *dry* filter into a clean dry glass, and, when sufficient has passed through, is ready for the fruit-sugar determination. If it is desired to determine the extractive matters *directly*, the precipitate in the flask is washed several times by decantation, and then placed on the filter (previously weighed), and the washing continued till a drop of the filtrate no longer gives a precipitate with H_2S; the filter and contents are then dried as usual. By the above method of treatment, a clear colourless solution is always obtained, which renders the further operations with the copper liquor much easier.

Chemical Laboratory,
144, West Regent Street, Glasgow.

Qualitative Detection of Arsenic in Organic and Inorganic Matter.—MM. Mayencon and Bergeret.—The authors place pure zinc in a small flask containing distilled water acidulated with pure sulphuric acid, and close its neck imperfectly with cotton-wool, to prevent drops of the liquid being thrown upon the test-paper, which is simply tissue paper moistened with a solution of bichloride of mercury, and used before it dries. If this paper is exposed to pure hydrogen no change appears; but if any arsenical compound is placed in the flask a lemon-yellow spot appears, which gradually deepens to a pale yellowish brown. Antimoniuretted hydrogen produces a brownish grey spot, quite distinct from the arsenical colouration. The reaction is exceedingly delicate.—*Comptes Rendus.*

ON THE

EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON AND STEEL BARS, AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Continued from p. 60.)

On the Elongations and Retractions observed in the Iron Rods as the Strength of the Magnetising Current is Gradually Increased and Diminished, and on the Equality in the Elongations produced by a Definite Current when it is Gradually and when it is Suddenly brought up to its Maximum Strength.

The observed sudden elongations taking place in an iron rod at the moment of its magnetisation naturally led me to inquire if the quantity of this elongation was in any way due to the suddenness of the magnetising action, and whether the elongation produced by a certain current which is gradually brought up to its maximum strength would equal that produced by the same current suddenly passed with the same maximum strength. This problem was also connected with a proposed simple and accurate means of measuring the changes in dimensions of bodies subjected to magnetisation, and I have therefore examined it with care in the following manner:—I cut the thick copper wire leading from the battery to the helix, and firmly attached one of its loose ends to a support. Between this copper wire and the opposite wall I stretched a fine wire of german-silver. The other loose end of the battery wire was bent into a sharp angle, and the vertex of this angle was well amalgamated. Now, by sliding this bent copper wire along the fine wire of german-silver toward the other copper wire, I could gradually diminish the resistance, and on touching the other end of the thick battery wire, this interposed resistance vanished, and the current gained its maximum strength. On slowly retracing our steps the resistance was gradually increased, until the whole length of the fine wire was interposed, and then the resistance was at its maximum and the strength of the current was at its minimum. But, if we brought the two amalgamated ends of the copper wire in contact, either with or without the intervention of a mercury cup, we at once could suddenly send the current with its maximum intensity through the helix.

Mean Results of First Series of Experiments. Resistance of Fine Wire = 0·6 ohm. One cell in circuit.

On gradually diminishing the resistance.

Fraction of length of fine interposed wire.

	1	¾	½	¼	⅛	0
Scale-readings went from 54·8 to	54·85	54·9	55	55·2	55·6	56·1

On gradually increasing the resistance.

Scale-readings went from 55·5 to	54·8	55·6	55·8	55·9	55·95	56·1
Tangent galvanometer	4½°	—	—	—	—	20½

Mean Results of Second Series of Experiments. Resistance of Fine Wire = 0·9 ohm. One cell in circuit.

On gradually diminishing the resistance.

Scale-readings	54·8	54·8	54·85	55	55·4	56·1

On gradually increasing the resistance.

Scale-readings went from 55·25 to	54·8	55·4	55·65	55·8	55·9	56·1
Tangent galvanometer	—	3°	—	—	—	20½°

Examining the results in the two series of experiments, we see that where the current was passed, with all of the interposed resistance in the circuit, the scale went from 54·8 to 54·85, or moved 0·05 of a division in the first series of experiments; but in the second series the current was too feeble to effect a measurable elongation, and it was not until ⅕ of the fine wire was out of the circuit that the scale-reading began to increase. In both series of experiments, the rapid increase in the rate of elongation is noticeable after ⅘ of the fine wire was out of the circuit; the elongation, in both series of experiments, amounted to 1·3 divs. of the scale. The same amount of elongation always occurred when the ends of the copper wires were brought together, or when the circuit was as suddenly formed by plunging the wires into a cup containing mercury. Therefore it is well established that a current of a definite strength will produce the same amount of elongation whether that strength is suddenly or gradually attained. Indeed, in some of the experiments, over three minutes were occupied in gradually decreasing the interposed resistance, until it was entirely out of the circuit, yet during this very slow increase of the current strength the scale slowly and smoothly moved upward in its readings, and when all the interposed resistance had been passed over the elongation again equalled 1·3 divs.

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* Read before the National Academy of Sciences, Cambridge, U.S.

The establishment of the above fact was of considerable importance, for it rendered applicable the following simple and precise method of measuring the change in dimensions of bodies on their magnetisation. Two iron, steel, or bismuth bars are placed parallel to each other, in V's, with their similar ends strongly pressed against a firm support, so that if the rods change their length on magnetisation, their free ends will move.

Now, imagine a lever so arranged that one end of it carries a plano-convex lens, and the other end a micrometer-screw. The convex side of the lens is opposite a plane-glass, which terminates the end of one of the rods, while the point of the micrometer-screw touches the end of the other rod, against which it is pressed by a spring. An inclined piece of plane-glass placed in front of the lens sends the light from a sodium-flame down to the lens and plane glass behind it, and by means of a microscope we can look through the inclined glass on to the lens, and thus accurately view and measure the Newton's rings, which we will now observe. If around the rods we now pass a voltaic current of gradually increasing strength, we will see the rings gradually displaced, and from the amount and direction of this displacement, together with the knowledge of the wave-lengths of the rays of the sodium light, we can accurately determine the amount and direction of the motion of the ends of the rods.

If, however, the current should have been passed at once with its full intensity, there would have followed a sudden displacement of the rings, but the amount and direction of this displacement it would have been impossible to determine. By making the arm of the lever which carries the convex lens longer than the arm which carries the screw, we can increase the delicacy of the apparatus, for it is understood that, as the rods move in the same direction, the rod carrying the plane-glass moves toward the lens, while at the same time the other rod, through the intervention of the lever, pushes the lens toward the plane glass.

The examination of the experiments of the first and second series contained under the heading "On Gradually Increasing the Resistance," makes known a remarkable phenomenon. In these experiments, the current, with its maximum strength, was first passed through the helix, and then it was gradually brought down to its minimum strength by sliding the copper battery wire over the fine wire of german-silver until the whole length of the latter was brought into the circuit. At the moment of sending the current with its maximum strength, the rod elongated 1·3 divs. of the scale; but if we now keep the circuit closed, but gradually diminish the strength of the current, we observe that the scale-readings do not correspond to those given when the corresponding strengths of current were reached by going from their minimum to their maximum, as the following tables, giving the differences of scale-readings in the two cases plainly show:—

First series of experiments.

Fraction of length of fine interpolar wire	1	⅘	⅗	⅖	⅕	0
On gradually diminishing the current	55·5	55·6	55·8	55·9	55·95	56·1
" increasing "	54·85	54·9	55·0	55·2	55·6	56·1
Differences	0·65	0·7	0·8	0·7	0·35	0·0

Second series of experiments.

Fraction of length of interpolar wire ..	1	⅘	⅗	⅖	⅕	0
On gradually diminishing the current	55·25	55·4	55·65	55·8	55·9	56·1
" increasing "	54·8	54·8	54·85	55·0	55·4	56·1
Differences	0·45	0·6	0·8	0·8	0·5	0·0

We thus see that the rod tends to persist in the elongation it acquired in first passing the maximum current, for it does not retract in proportion to the diminished strength of this current; and the experiments show that even when the current is so far diminished in strength that it would, if suddenly thrown through the helix, be unable to elongate the rod sufficiently to be measurable, yet this feeble current holds the rod elongated 0·45 of a div. in the second series of experiments, but on breaking the circuit the rod instantly retracts 0·45 of a div in the second series of experiments and 0·65 of a div. in the first series, and regains the length it had before the current was passed around it.

On passing the current with the whole of the fine wire in the circuit, we have, in the first series of experiments, an elongation of 0·05 of a div., but, on making the circuit without the interposed fine wire, we have an elongation of 1·3 divs.; and if we now do not break the current, but gradually diminish its strength by increasing the interpolar resistance, we find that when the whole of the fine wire is again in the circuit, that the elongation is yet 0·65 of a div.; whereas, when the circuit was at once formed with this same interposed resistance, the rod was elongated only 0·05 of a div.

The discovery of this most remarkable phenomenon was contained in the above experiments, but, to be sure that my experiments should not mislead me, I repeated them several times, using every precaution to ensure their accuracy, and obtained results almost identical with those formerly observed. I am, therefore, confident that I have discovered a phenomenon worthy of minute study, and I purpose to make it the subject of a special investigation.

Unfortunately, during the above experiments, I did not make a parallel series of determinations of the magnetic intensities of the rod during the successive stages of passing a current of increasing and of decreasing strength. Yet I can hardly believe that the magnetic intensity will be kept up with the persistent elongation of the rod when it is slowly demagnetised, but I think it will be found that the magnetic intensity of the rod depends alone on the strength of the current traversing the helix. The phenomenon, indeed, shows that the molecules of the rod, on its elongation by magnetisation, having been forced into new positions, that either by what might be well called a "magnetic set,"* or from molecular friction, the molecules retained these new positions with such persistence, that it required the sudden shock of the induced current, produced on breaking the circuit, to cause them to rush to their positions of stable equilibrium.

Effects observed on Making and Breaking Separate Currents in the Component Helices of the Compound Helix.

In these experiments two batteries were used. In the outer helix I made and broke a current from 16 cells, arranged four coupled and four in series. In connection with the inner helix, I used a battery of 25 cells, connected five in a row and five in series. The experiments are interesting as showing the effects of the induced currents formed on making and breaking the circuits in the various manners given in the following experiments:—

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* The term "magnetic set," as applied above, is, from analogy, an appropriate name for the phenomenon; but it cannot well be so applied, for Dr. Joule has already appropriated "magnetic set" as designating the residual magnetism an iron rod retains after its electro-magnetisation.

(1). Made circuit in inner helix, rod elongated 1·4 divs.
„ „ outer „ „ 0·25 „
Broke „ „ „ retracted 0·25 „
„ „ inner „ „ 1·4 „

(2). Made circuit in outer helix, rod elongated 1·5 divs.
„ „ inner „ suddenly retracted 0·4 div., and then suddenly elongated 0·4 div.
Broke circuit in inner helix, rod suddenly retracted 0·4 div., and then suddenly elongated 0·4 div.
Broke circuit in outer helix, rod retracted 1·5 divs.

(3). Made circuit in inner helix, rod elongated 1·4 divs.
„ „ outer „ „ 0·25 „
Broke circuit in inner helix, rod suddenly retracted 0·35 div., then suddenly elongated 0·35 div.
Broke circuit in outer helix, rod retracted 1·65 divs.

(4). Made circuit in outer helix, rod elongated 1·5 divs.
Made circuit in inner helix, rod suddenly retracted 0·5 div., then suddenly elongated 0·05 div.
Broke circuit in outer helix, rod retracted 0·1 div.
„ „ inner „ „ 1·4 divs.

On the Times Occupied in the Elongations and Retractions of a Rod when the Two Component Helices are Joined as One Helix, and Placed in the Circuit of One Battery.

The determinations I here give were made with the eye and a chronograph, and although not as accurate as the interest of the research demands, yet are near enough to the truth to show that the subject is worthy of a careful investigation. The experiments given under the above heading and the succeeding one give an insight into the *velocities* of the molecular motions, and therefore these determinations, taken in connection with the measures of the corresponding elongations and retractions, will be of considerable theoretic interest, when they have been determined with the precision which the following proposed apparatus will, in all probability, afford.

I thus propose to attack this problem. The mirror of the apparatus will be made of the minimum weight consistent with stability. The mirror will reflect a pencil of light from an electric lamp to a revolving glass disc coated with sensitised collodion. This converging pencil will form a dot of light on the disc, and when the latter is stationary will, on the elongation of the rod, describe a portion of one of its radii, which will appear on developing the sensitised plate. If, however, the disc has an uniform and known rate of rotation, the dot will, on the elongation of the rod, describe a curved line which, referred to the appropriate ordinates, will give not only the time of the motion of elongation, but also the mode or law of this motion. Of course the motion of retraction can be studied in like manner.

The following experiments were made on rod No. 3, of English refined iron, and each result is the mean of fifty experiments:—

		Time of Elongation.	Time of Retraction.
(1).	25 cells ..	$\frac{1}{10}$th of a second.	$\frac{6}{10}$ths of a second.
(2).	One cell ..	$\frac{3}{10}$ths „ „	$\frac{1}{10}$th „ „

It is thus seen that, with 25 cells, the duration of the retraction is six times as long as the duration of the elongation, but with a current of one cell the phenomena are reversed, and the duration of the elongation is three times that of the retraction.

Determinations of the Times Occupied in the Elongation and the Retraction of a Rod when the Inner or the Outer Helix forms in itself a Closed Conductor, while the Current is Passed, in the respective cases, in the Outer and in the Inner Helix.

(1). Terminals of inner helix *not* joined. Current passed through the outer helix from 25 cells. Elongation of the rod, 1·5 divs. Times of elongation, $\frac{1}{10}$th of a second. Times of retraction, ½ sec.

(2). Same result as above when the outer helix was open, and the current was passed through the inner helix.

(3). The terminals of inner helix united; so that this helix formed a closed circuit in itself. Current from 25 cells passed through outer helix. Elongation, 1·5 divs. Time of elongation, $\frac{3}{10}$ths of a second. Time of retraction, $1\frac{1}{10}$th seconds.

(4). Same results as above when the terminals of the outer helix were united, and the current passed through the inner helix.

(5). One cell used. When the terminals of the outer or inner helix were *not* united, and the current passed respectively through the inner and outer helix, the elongation was 1·1 divs. The time of elongation, $\frac{5}{10}$ths of a second. The time of retraction, $\frac{3}{10}$ths of a second.

(6). One cell used. The terminals of inner helix united. The elongation was 1·1 divs. Time of elongation, $\frac{8}{10}$ths of a second. Time of retraction, $1\frac{3}{10}$ths seconds.

(7). Same result as experiment (6) when the terminals of outer helix were joined, and the current from one cell passed through the inner helix.

To observe a rod slowly retracting during 1·3 of a second was a most remarkable sight, and suggests many thoughts as to the interaction of the induced currents passing in the helices and rod. I may here venture to suggest that the study of these extraordinary phenomena—which I believe I have here first made known—will eventually be of some service in the study of induced currents. For the present, I am content with merely presenting *the facts*, for I have not yet been able to command the time which their investigation will require.

In experiments (3) and (6) the time of retraction was, respectively, $1\frac{1}{10}$th seconds and $1\frac{3}{10}$ths seconds, and the slowness of these motions allowed me to obtain an insight into their character. In each of these experiments the rod retracted with a gradually diminishing velocity, and the motion reminded one forcibly of that pertaining to a body projected vertically upward.

(To be continued.)

CORRESPONDENCE.

ON COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—I had not intended to notice the remarks of Messrs. Teschemacher and Smith in Chemical News, vol. xxix., p. 280, because the personality carries its own condemnation; but, as in a former case with Mr. Tatlock, these gentlemen have misconstrued my silence, and have re-published and largely circulated these personalities in the assuming form of a *scientific paper*.

We have shown that one of the processes employed by these gentlemen is inaccurate; they have yet to show that it is accurate. With regard to the disputed cargo of coprolites, I can only say that my examples were given me by a superphosphate maker; and, as he worked up the cargo, he should be an unquestioned authority as to which analysis was right. As to the publication of our private letters, although I can have no objection, I fear your readers would dislike to see the columns of your scientific paper defaced with letters even more personal than those you have already published from the same source.

As to the general question, Sir, that is now out of the range of Mr. Teschemacher and myself; your stirring leaders have induced the country at large to take it up, and my slight treble note of warning has been drowned in the deep base roar of my countrymen. An angry public voice has been heard, which will not be silenced until the scandal of "high and low chemists" and incompetent Public Analysts has been for ever swept away. Mr. Tatlock has informed you of the resolution passed by the Glasgow Philosophical Society, and I would add that the Newcastle Chemical Society held a special meeting to consider this question, and passed the following resolutions:—"That this Society desires to support the recommendation of the

Chemical Section of the Glasgow Philosophical Society, as to the methods employed in chemical analysis, and that a communication to that effect be forwarded to the Secretaries of the Section. They also recommended that the following substances should be included in the investigation:—Copper, soda, potash, sulphur, superphosphates, and other manures. The following resolution was also passed:—"That this Society is of opinion that the sub-committee suggested might also usefully inquire into the question of instituting a professional examination for a diploma, without which no person should be legally qualified as a Public Analyst." Thus almost exactly forestalling the resolution adopted at the late meeting of Public Analysts in London.

Although Mr. Teschemacher accuses the "hazy writers of Newcastle" of "incompetency," and disbelieves the importance of the city of Glasgow as a producer of potash salts, I can assure him that the chemical manufacturers of both these cities are not behind the age, and they are determined to have rigid accuracy in commercial analyses, and they will attain that accuracy regardless of any amount of ink which may be thrown over them.—I am, &c.,

Edward C. C. Stanford, F.C.S.,
President of the Chemical Section of the Glasgow Philosophical Society.

Carruth, Bridge of Weir,
August 17, 1874.

MR. TATLOCK'S REPLY.

To the Editor of the Chemical News.

Sir,—After a six years' silence, Mr. Tatlock has noticed a memoir of ours, "On the Estimation of Potash," you favoured us by inserting in the Chemical News, of May, 1868.

He now charges us with condemning his process:—"Messrs. Teschemacher and Smith took it upon themselves to condemn the process as described by us." Doubting the accuracy of this statement, we, not trusting to our memory, have re-perused this memoir of ours, and would fain ask Mr. Tatlock to do the same. Should he so far favour us, he will be the first to perceive the injustice of his charge, and to admit that we did not condemn his process.

We condemned, not his process, but his conclusion that pure platinum was requisite to determine potash. We denied it then, and we deny it now.—We are, &c.,

E. F. Teschemacher and J. Denham Smith.

London, August 21, 1874.

[This correspondence must now close.—Ed. *C.N.*]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, No. 1, July 6, 1874.

Researches on Solution, Crystallisation, Precipitation, Dilution.—M. Berthelot.—This interesting paper does not admit of useful abstraction.

Spectrum of the Comet of Coggia.—P. Secchi.—On June 18 and 19 the spectrum with the bands of carbon was considerably developed, the green band remaining the most distinct, whilst in the comet of Temple the yellow was brightest. This proves that the gaseous compounds are not the same in all comets. At the beginning of the month there was merely a spectrum of bands, now there is a general connecting line which unites them into one continuous spectrum. The bands of the comet are more diffuse than those of carbonic oxide. They resemble the spectrum obtained by the electric spark in the vapour of benzine.

Photographic Apparatus Adopted by the Commission for the Transit of Venus.—A reclamation of priority.

Helioscope.—M. Prazmowski.—The author describes the construction of a new helioscope. He remarks that the idea of employing the polarisation of light in place of coloured glasses to diminish the lustre of the sun is not novel; but the quantity of light reflected, even under the Brewsterian angle for glass of a low index ($n = 1\cdot5$) is so considerable that the eye cannot support the light. The author obviates this difficulty by taking a rectangular prism of an index, n, and cementing upon its hypothenuse another similar prism, so as to form a cube. The index of the second prism is n'. A ray of light meets in its course the first hypothenuse of the cemented pair with an incidence of 45°; this is the surface whose index is $\frac{n}{n'}$; As $\frac{n}{n'}$ is very nearly unity, the angle of 45° is very near the Brewsterian incidence. The instrument has been further modified by Janssen.

Diffusion of Light, and the Illumination of Transparent Bodies.—J. L. Soret.—The author has examined if a perfectly homogeneous and non-fluorescent medium can be illuminated by the passage of a pencil of solar light. The possibility of a lateral propagation of light in such cases is contrary to what has been hitherto admitted on the undulatory theory. Most fine specimens of hyaline quartz, pure enough to be employed in the construction of prisms, are not perfectly homogeneous, and when traversed by a pencil of solar light they display the phenomena of illumination. The trace of the rays is very visible—completely polarised. On examining this trace it is generally fonnd due to diffusion, either in consequence of slight defects of crystallisation, or to minute cavities. Some very pure and rare specimens are free from the power of illumination. Yellow quartz (common topaz) is strongly illuminated; the trace of the luminous pencil is blue, and presents a complete polarisation. When a pencil of rays, previously polarised, is caused to pass in the direction of the crystallographic axis, the beautiful experiment of M. Lallemand upon liquids possessing rotatory power is reproduced upon a small scale. A very pure specimen of amethyst was found completely void of illuminating power. Smoke-quartz is in general far from homogeneous. These observations appear to prove that the power of illumination only springs from deficient homogeneity.

Formation of Solar Spots.—M. Tacchini.—A reply to the last note of M. Faye.

Transmission of Electricity through Woody Bodies.—Th. du Moncel.—The author's experiments show that the conductibility of wood is due in great part, if not altogether, to the presence of moisture.

Analysis of Beers and Malts.—Ch. Mène.—A tabular view of the results of the analysis of certain samples of beer and malt, from the exhibition in the Pavillon du Progrès.

No. 2, July 13.

Observations on the Recent Paper of M. Tacchini, and the Memoir of M. Langley.—M. Faye.—A continuation of the discussion on the structure of the solar photosphere, and on the cyclonic theory of spots in the sun.

Chemical Actions, other than Metallic Reductions, Produced in Capillary Spaces.—M. Becquerel.—Capillary communications between two liquids give rise to chemical action, and to effects of diffusion, endosmose and exosmose, as well as to electro-capillary currents, which are so many causes capable of exciting chemical action. The electro-capillary currents are merely concerned in the reduction of metals from their solutions when the electro-motive force is great. If it is less, oxides and compounds of oxides result, and below a certain limit affinities and other causes act alone. If the electric force is considerable, as in case of alkaline sulphides and metallic salts, metallic reductions appear, a fact inexplicable from mere affinity, since the mixture of such liquids would yield metallic sulphides. Split tubes, which produce good results in experiments of reduction, are unfit for the formation of oxides. In these cases it is better to employ tubes closed with parchment paper, or dry collodion. Phenomena of endosmose and exosmose are rarely manifested in these experiments. In explaining the effects produced we must take into account the affinities, the action of the electro-capillary currents, the effects of endosmose and exosmose, and likewise the transportation of matter from the positive to the negative side of the septum effected by the electro-capillary currents. The author has obtained hydrated oxide of copper in blue, double-refracting, acicular crystals; oxides of lead, zinc, cobalt, and nickel, &c.; silicate of lime in tubercles composed of doubly refractive microscopic crystals; crystals of alumina, which, however, are not hard enough to scratch glass; a crystalline and doubly refractive aluminate of magnesia; crystalline and hydrated peroxide of iron; crystalline oxide of manganese; silicate of alumina; and a basic chromate of lead, having the composition of melanochroite.

Chemical Achromatism.—M. Prazmowski.—Considerations on the construction of objectives for photographic cameras, so that the most luminous part of the spectrum may coincide with that portion where chemical action is most powerful.

Second Note on the Electric Conductivity of Wood.—M. Th. du Moncel.—The author finds that the conductivity of wood undergoes all the changes which affect the hygrometer, but that these variations are much more slow in one case than in the other. The conductivity of wood is greatest at 6 a.m., and attains its minimum at 6 p.m., whilst the daily hygroscopic maximum and minimum fall about 3 a.m. and 3 p.m.

Indications Furnished by Conjugated Thermometers in a Vacuum.—M. Marié-Davy.—This paper is an examination of actinic action as one of the principal elements of a climate as regards its action upon vegetation. The author finds that, so far, the present year differs little in mean temperature from the year 1873, but greatly exceeds the latter in its actinometric mean. He considers that the great amount of light is connected with the early maturity and good condition of cereals this year.

Action of Heat upon the Carbides Isomeric with Anthracen, and upon their Hydrides.—M. Ph. Barbier.—The author finds that the three isomeric carbides—anthracen, phenanthren, and tolan can be formed with toluen. He has not succeeded in directly transforming any of these into the others. Of the three isomeric hydrides, benzyl yields, in the moist way, tolan, and in the dry way phenanthren; liquid tolyl yields anthracen with a notable proportion of phenanthren; benzyl-toluen yields anthracen with a trace of phenanthren.

Analysis of Samples of Wines from the Exhibition in the Pavillon du Progrès.—Ch. Mène.—A tabular view of the percentage of alcohol and saline matter, of the syrupy residue per litre, and of the specific gravity of the samples.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 10, June 22, 1874.

Influence of Light upon Cinnabar.—K. Heumann.—The author finds that cinnabar prepared in the moist way, by digesting penta-sulphide of ammonium, is decomposed by light much more rapidly than the sublimed variety. The intensity and speed of the blackening depend on the nature of the supernatant liquid. Cinnabar prepared in the moist way is not blackened at all if covered with a layer of dilute nitric acid. Under pure water the change is very slow, whilst it is greatly accelerated by the presence of an alkaline liquid, especially ammonia.

Desulphurisation of Cinnabar at Low Temperatures.—K. Heumann.—To detect metallic mercury in commercial cinnabar (vermillion) the author rubbed the samples with water upon bright sheet copper, in the opinion that free mercury would be detected by the appearance of amalgamation. As the copper became amalgamated in every case, whilst no mercury was dissolved out of the samples by dilute nitric acid, it became apparent that copper is capable of decomposing cinnabar. On boiling cinnabar in water with powdered copper the red colour of the mixture disappears, and is succeeded by a black-grey, from the production of sulphide of copper. Powdered zinc had a more energetic action, though here also the sublimed variety appeared more stable than that formed in the moist way.

Communications from the Laboratory of the University of Louvain.—Louis Henry.—These communications consist of a hypothetical paper on lactid; an account of the addition-products of hypobromous acid with the allyl compounds, and of the triple glycerin derivatives, $C_3H_5XX'X''$; on chloro-brom-propionic acid; on the preparation of the acetylous hydrocarbons; on the radical propargyl; and on the alcohol derivatives of chloral.

Preparation of Iodide of Potassium from Cuprous Iodide.—G. Langbein.—Cuprous iodide, which now arrives in considerable quantities from Peru, containing from 60 to 66 per cent of iodine, is a cheap and convenient material for the preparation of pure iodide of potassium. In the following process the outlay is covered by the secondary products:—The cuprous iodide is freed from soluble matters by washing, and is then suspended in water in the state of a fine powder. It is acidulated with a few drops of hydrochloric acid, and treated with sulphuretted hydrogen, with constant agitation, until all the cuprous iodide is converted into hydriodic acid and sulphide of copper. This may be known by the circumstance that the deposit is a pure black, free from white granules of cuprous iodide. Sometimes small quantities of sulphate of lime are present, which may prove deceptive. The entrance of the sulphuretted hydrogen gas is then stopped. Any excess of this reagent is decomposed by adding iodine dissolved in iodide of potassium, the mixture well stirred up, and the sulphide of copper allowed to settle. The solution of hydriodic acid, which is still somewhat turbid owing to precipitated sulphur, is drawn off, the residue well washed with water, and the washings used instead of water in the next operation. The hydriodic acid is now neutralised, either with potash lye or bicarbonate of potash, and evaporated to crystallisation. During the evaporation the sulphur coagulates, and settles to the bottom of the vessel. The solution of iodide of potassium, when it has arrived at the proper degree of concentration, is strained off into crystallisers perfectly free from sulphur. From 2·177 grms. of the ore, containing 66 per cent of iodine, or 1·436 grms., were obtained 200 c.c. of a solution of iodide of potassium, containing 1·428 grms. of iodine. The loss was therefore merely 0·008 grm. The very pure sulphate of iron covers the cost of acid, and sulphide of iron, and the blue vitriol formed by roasting the sulphide of copper, equals in value the amount expended for bicarbonate of potash, fuel, and labour.

Tri-Cyan-Hydrogen—a Polymer of Hydrocyanic Acid.—R. Wippermann.—The compound in question was accidentally obtained on heating hydrocyanic acid, and epichlorhydrin together in a sealed tube.

Existence of Definite Hydrates in the Aqueous Solutions of Acids.—Julius Thomsen.—A thermo-chemical paper. The author, in opposition to Berthelot, denies the existence of such hydrates.

On Guanamin.—M. Nencki.—An account of the properties and composition of guanamin, $C_4N_5H_7$; and of its hydrochlorate, platino-chloride, nitrate, sulphate, and acetate.

Sulphurea Oxalic Ether.—M. Nencki.—This compound, obtained by mixing oxalic ether with an alcoholic solution of sulphurea has the composition—

$$(CSN_2H_4)_2C_2O_2(C_2H_5O)_2.$$

On Laureo-Stearin.—Hugo Schiff.—This substance was first analysed by Marsson in 1842. Its composition may be expressed by the formula $C_{27}H_{50}O_4$. The author regards it as a tri-acid derivative of glycerin.

On Chrysochinon.—C. Graebe.—Chrysochinon corresponds to phenanthren-chinon, and not to anthrachinon. With acid sulphites of the alkalies it forms colourless compounds soluble in water. If dry chrysochinon is treated with a solution of the acid sulphite of soda it dissolves with great difficulty, but it is totally soluble at a gentle heat if previously moistened with alcohol. Stronger acids precipitate chrysochinon from its solutions in the shape of orange microscopic needles. If heated to 180° in a sealed tube with aqueous ammonia it is converted into a nitrogenous body.

Nitrol Acids.—Victor Meyer and J. Löcher.—The authors treat of the spontaneous decomposition of propylnitrolic acid, and of a product obtained from the reaction of pseuco-nitro-propan and nitrous acid.

Constitution of Nitro-Butan.—Eugen Demole.—Not suitable for abstraction.

Communications from the Laboratory of the University of Gottingen.—H. Hübner.—These consist of papers on thihydro-benzoic acid, dithio-benzoic acid, and brom-thihydro-benzoic acid, by F. Frerichs; on metabrom-toluol, by E. A. Grete; on α-para-chlor-sulphitoluol, and nitro- and amido-para-chlor-toluols, by A. Englebrecht; on certain compounds of lanthanum and didymium, by F. Frerichs. This chemist separates the oxides of lanthanum and didymium by two methods. The first process consists in heating the mixture of the two oxides in a current of chlorine gas, adding water to the mixed oxychlorides thus obtained, and setting the whole aside in a warm place. If so much lanthanum was present that three equivalents of it entered into reaction for every six of didymium, the solution, after prolonged digestion, contained merely chloride of lanthanum, whilst the deposit consisted of a mixture of hydrous oxide of didymium and oxychloride of lanthanum. If didymium was present in larger proportion, a product was obtained rich in lanthanum, which yielded a pure preparation on repetition of the process. In the second method, the mixture of both oxides was dissolved in nitric acid, and to the solution so much of a standard sulphuric acid was added that not quite all of the lanthanum was converted into a sulphate. After standing for several days all the sulphuric acid was found combined with the lanthanum, as the more positive of the two metals. The nitrate was decomposed by evaporation and gentle ignition, and the sulphate alone extracted in water. To obtain pure compounds of didymium so much sulphuric acid was added to the solution of the mixed nitrates that all the lanthanum and a part of the didymium were converted into sulphates. On evaporating and igniting gently a mass was obtained, from which water withdraws all the lanthanum and a part of the didymium in the state of sulphates. The residue when dissolved in sulphuric acid furnishes a pure sulphate of didymium. The Gottingen communications further contain a paper by F. Frerichs on the separation of barium from strontium, calcium, and magnesium by means of neutral chromate of potash.

Separation of Barium and Strontium.—Well crystallised nitrates of baryta and strontia, finely powdered, were exposed for two to three hours to a temperature of 80° or 90° in the drying closet. Small amounts of the dried salts were weighed, dissolved in water, mixed with acetate of soda and acetic acid in excess, and so much of a solution of neutral chromate of potash added. After standing for some hours the precipitate was filtered and ignited. The results were—

		Calculated.	Found.
Ba	..	0·2134 = 24·63 per cent	0·2135 = 24·64
Sr	..	0·1901 = 21·94 " "	0·1900 = 21·93

Barium is separated from calcium in a manner quite analogous. The lime in the filtrate was first thrown down with ammonia and carbonate of ammonia, boiled for some hours, filtered, the precipitate dissolved in hydrochloric acid, and the lime re-precipitated from this solution by means of ammonia in excess, and oxalate of ammonia. Direct determination of lime by oxalate of ammonia in presence of chromate of potash was not successful. The separation of barium from magnesium was satisfactory.

Palladio-Chloride of Aluminium.—A. Welkow.

Palladio-Chloride of Beryllium.—A. Welkow.—Accounts of the composition and chemical properties of these salts, with a crystallographic description of the former.

Synthesis of Anthrachinon-Sulphuric Acid.—C. Liebermann.—If β-benzol-benzoic acid is heated for some time with fuming sulphuric acid till water no longer produces a precipitate in the mixture, it is converted into anthrachinon-sulphuric acid. Alizarin prepared from this acid possessed its ordinary properties.

Rectification.—C. Liebermann.—In a former communication the author stated that the series of colouring matters formed from the phenols by treatment with nitrous sulphuric acid had no affinity for animal fibres, and did not appear suitable for dyeing. This statement is correct if the experiment is tried in an aqueous or slightly alkaline bath. In dilute alcoholic, slightly acid solutions, or in alkaline solutions mixed with an excess of acetic acid, they dye silk, producing in some cases good colours. The tinctorial bodies obtained from phenol, cresol, and resorcin give shades from olive to buff, the orcin compound a fine orange, and the thymol a violet.

On Suberon.—C. Schorlemmer and R. S. Dale.—Not adapted for abstraction.

Explanation.—Gorup-Besanez.—In reference to imperatorin and ostruthin (see *Berichte*, No. 9).

Action of Nitrous Acid upon Dimethylanilin.—A. Baeyer and H. Caro.—The authors are of opinion that they have obtained the long-sought-for nitrosophenol, a body soluble in water, turning orange on the addition of alkalies. In alkaline solutions it is stable, but in presence of acids easily decomposed. Concentrated hydrochloric acid, at a gentle heat, reacts so violently that the mixture boils. Tin and hydrochloric acid readily decolourise the brown solution. Nitrosophenol cannot exist in presence of nitric acid.

Phenyldiamin as a Secondary Product of the Manufacture of Aniline.—A. W. Hofmann.—Reserved for insertion in full.

Desulphurisation of the Phenyl-Mustard Oil.—A. W. Hofmann.—A reply to Weith's paper, *Berichte*, vii., 722.

Polytechnisches Journal von Dr. E. M. Dingler,
Band 210, 3.

Fabrication of Cast-Steel according to the Procedures of Bessemer and Martin-Siemens.—Noblet.

New Process for Hardening Steel, and on the Restoration of Burnt Iron.—H. Caron.

Determination of Sulphur in Cast-Iron, Wrought-Iron, and Steel.—M. Koppmayer.

Application of Bisulphate of Potash for the Recognition of Galena in Mixed Ores.—E. Jannetaz.

Utilisation of Platinum Residues.—Th. Knösel.

Alizarin as an Indicator in Titration.—Eng. Schaal.

Use of the Bog Iron Ore of Budin (Bohemia) for Purifying Coal-Gas.

Band 210, 4.

Rapid Colorimetric Method for Determining the Manganese in Pig-Iron, Steel, Iron, and Ores.—Aug. Brunner.

Qualitative and Quantitative Examination of Chromate of Lead for Adulterations.—G. C. Witstein.

Carbonic Acid of the Atmosphere.—P. Truchot.

Examination of Potable Waters.—Ferd. Fischer.

Presence of Copper in Water which has passed through Copper Tubes.—E. Reichardt.

Occurrence of Arabinic Acid in the Sugar-Beet, and on Arabinose.—C. Scheibler.

Band 210, 5 and 6.

Contribution to the History of the Alloys of Manganese.—v. Schroeter.

Manufacture of Alum in Montionl.—Kurtz.

Qualitative and Quantitative Determination of Hypochlorous Acid in Presence of Chlorine, Chlorous, and Chloric Acids.—Walters.

Process for Determining the Percentage of Aniline Colours by Means of the Hydrosulphite of Soda.—Stamm.

Uses of Soap in Textile Manufactures.—Vohl.

Examination and Composition of Extract of Meat.—E. Reichardt.

Manufacture of Meat-Flour.—Hulwa.

Influence of Beet-Gum (Arabinic Acid) upon the Manufacture of Beet-Root Sugar.—Scheibler.

Articles made from Fats at the Vienna Exhibition.—Schwartz.

Limousin's Apparatus for Evolving Oxygen for Medical Purposes.—Hildwein.

Action, and the Relative Value of Disinfectants.—J. A. Wanklyn.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Belfast meeting, under the presidency of Dr. A. Crum Brown, F.R.S.E., &c. They will be published, in full or in abstract, according to their importance, in the Chemical News:—

President's Address.

Professor G. C. Foster.—On Siemens's Pyrometer.

Professors Roscoe and Williamson.—Report of Committee for Superintending the Monthly Reports of the Progress of Chemistry.

W. Chandler Roberts.—Report of Committee on Essential Oils.

Professor Hodges.—The Chemical Composition of Jute Fibre.

Professor Brown and Dr. E. A. Letts.—Methyl-thetine.

Dr. C. R. A. Wright.—On some Opium Derivatives.

Professor Corfield.—Report of the Committee for the Utilisation of Sewage.

Dr. Carpenter.—On the Replacement of Organic Matter by Siliceous Deposits in the Process of Fossilisation.

Professor Hodges.—On the Silicified Rock of Lough Neagh.

Professor Roscoe.—On a Self-Registering Apparatus for Measuring the Chemical Action of Light.

Professor Roscoe.—On Certain Abnormal Chlorides.

Professor Thorpe.—On the Specific Volumes of Certain Liquids.

Messrs. Braham and Gatehouse.—On the Dissociation of Nitric Acid.

Professor Andrews.—Experiments at High Pressures.

Dr. Dewar.—On the Latent Heat of Liquefied Gases.

Dr. Dewar.—Report of the Committee on the Estimation of High Temperatures.

Professor Debus.—On Spontaneous Generation, from a Chemical Point of View.

Mr. Ogilvie.—On the Estimation of Phosphoric Acid as Pyrophosphate of Magnesia.

W. Jesse Lovett.—On an Improved Form of Filter Pump.

Professor Emerson Reynolds.—Notes on the Preparation of the Sulphur-Urea.

Professor Emerson Reynolds.—On the Action of the Sulphur-Urea in Metallic Solutions.

Lowthian Bell.—On the Joint Action of Carbonic Acid and Cyanogen, on Oxide of Iron, and on Metallic Iron.

Professor Gladstone and Mr. Tribe.—Electrolytic Experiments on Metallic Chlorides.

W. Chandler Roberts.—Report of Committee on Methods of Making Gold Assays.

Professor Hodges.—Analyses of Indian Teas.

W. J. Cooper.—Composition of Certain Kinds of Food.

Mr. Fairley.—New Reactions of Peroxide of Hydrogen Hypochlorous Acid, and Ozone.

Mr. Fairley.—Hypochlorous Acid and Ozone. Synthesis of Perchloric Acid.

Professor Maxwell Simpson.—On the Chlor-Bromides and Brom-Iodides of the Olefines.

Professor Andrews.—On an Aspirator.

Professor Delffs.—On an Aspirator.

Professor Clifford.—On the General Equations of Chemical Decomposition.

Dr. T. L. Phipson.—On the Presence of Cyanogen in Commercial Bromine, and a Means of Detecting it.

Dr. T. L. Phipson.—On a Sesqui-Sulphide of Iron.

Professor Armstrong.—Report on Isomeric Cresols.

W. Charley.—On the Injurious Effects of "Dew-Rotting" Flax.

P. Braham.—Mode of Producing Spectra on the Screen with the Oxy-Hydrogen Flame.

Professor Crum Brown.—On the Mode of Writing Chemical Equations.

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Place of Meeting for Next Year.—The meeting next year will be held at Bristol. President Elect—Sir John Hawkshaw, C.E., F.R.S. Glasgow has been selected for the meeting of 1876.

On the day of the opening of the Belfast meeting of the British Association the death was announced of Sir William Fairbairn, Bart., F.R.S. Sir William was one of the founders of the Association, and presided over the meeting held in 1861. He died on the 18th inst., in the eighty-fifth year of his age.

The Priestley Centennial.—The meeting of American Chemists to commemorate the discoveries of Priestley, to which we alluded a few weeks ago (see Chemical News, vol. xxx., pp. 17, 31), was held at Northumberland, Pa., on July 31st and August 1st. The following gentlemen were appointed permanent officers:—*President*—Professor C. F. Chandler. *Vice Presidents*—Professor Rachel L. Bodley, Professor J. W. Draper, Professor Silas H. Douglas, Dr. A. H. Gallatin, Professor E. W. Hilgard, Professor E. N. Horsford, Professor J. W. Mallet, Professor S. St. John, Dr. H. C. Bolton, Professor A. P. S. Stuart, Professor T. G. Wormley, Professor Henry Wurtz, and Professor C. A. Joy. *Secretary*—Professor Albert R. Leeds. *Treasurer*—Professor William H. Chandler. *Finance Committee*—Professor T. R. Pynchon, Professor Traill Green, Professor A. P. S. Stuart, Professor H. Wurtz, Professor Persifor Frazer, Professor B. F. Hedrick. *Committee on Resolutions*—Professor B. Silliman, Professor J. W. Mallet, Professor J. E. Smith, Professor William H. Chandler. *Committee on Scientific Papers*—Professor C. A. Joy, Dr. T. W. Drown, Professor F. W. Clarke. *Committee on Telegraphy*—Professors Frazer, Sharples, and Wheeler. Professor J. Lawrence Smith submitted the following resolution, which was carried unanimously:—Resolved, that a committee be appointed to confer with the Committee of the Centennial Exhibition, to correspond with chemists and professors of cognate sciences in Europe, in order to induce as large a representation as possible of them to visit our country in 1876. In pursuance of this resolution the Chairman appointed to act on this committee Professors J. L. Smith, Gibbs, Hunt, Mallet, Joy, Leeds, Bolton, Horsford, Silliman, Barnard, and Barker. Addresses were delivered by Professor H. H. Croft, Professor T. Sterry Hunt, Dr. Henry Coppee, Professor J. Lawrence Smith, Professor Silliman. In future Nos. of the Chemical News we shall give abstracts of these addresses. Mr. Waller moved that the balance deposited by the Treasurer, Professor William H. Chandler, in the hands of the Secretary be expended for a suitable photographic album, and that all the gentlemen who have placed their names on the Treasurer's list are requested to send their *carte de visites* to Dr. H. Carrington Bolton, School of Mines, New York, as also their autographs on a separate paper, which will be inserted below their photographs. It is proposed to present this memorial photographic album to Dr. Joseph Priestley and his family, to be preserved by them and their descendants until the meeting of the next Centennial of Chemistry in Northumberland, Pa., on the 1st of August, 1974. A number of appropriate resolutions were passed, recognising the hospitalities and kindnesses shown by the people of Northumberland to the chemists on the present occasion, after which the meeting was adjourned.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of wool, silk, and other animal textile materials in a manufactured state. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Jean Baptiste Frezon, the elder, Paris). December 6, 1873.—No. 4027. This invention relates to certain improvements on the process described in the Specification of an invention for which Letters Patent were granted to me on behalf of the said Jean Baptiste Frezon, No. 861, 1867, and consists essentially as follows:—First. In the extension of the limits of saturation and of the temperature of the acid baths employed. Second. In the dispensing in most cases with the baths previously employed for preserving the wool from the action of the chemicals used in destroying the vegetable matters, it having been discovered that the wool itself generally contains sufficient fatty matter to preserve it from contact with the action of the acids employed in destroying the vegetable matters mixed therewith. Third. In the special application to silk of the improved process; and lastly, of a process for destroying the vegetable matters, and simultaneously mordanting the fabrics or materials to be dyed or bleached.

Improvements in the treatment and disposal of sewage. Henry Malcolm Ramsay, civil engineer, Amyand Park Road, Twickenham. December 12, 1873.—No. 4092. 1. The purification of sewage as delivered or discharged from the sewers, tanks, pumping-main, or other means, by distribution under the surface of any suitable land through a system of open half-pipe or circular perforated filter-drains, laid in trenches in parallel lines, about 12 feet apart, upon a bed of, and surrounded by, coarse filtering material, the trenches being filled in over to surface-level. 2. The disposal of any portion of the supplies of sewage at option over surface for cultivation purposes. 3. The area of land in each case to be divided into 1-acre plots or thereabouts, the system of filter-drains being laid in sets to each plot distinct, supplied and charged from delivery-conduit or otherwise, as the position of the works or contour of the locality may determine, each plot or set of filter-drains being so charged in rotation, allowing an ascertained time, dependent in each case on the nature of the subsoil, for filtration and absorption, the land being further underdrained in the usual manner at such levels as found desirable. 4. The disposal of sewage at any time of the year, without stoppage from frost or other interruptions, such as occurs in disposal by surface irrigation. 5. The disposal of sewage without creating any surface nuisance or objectionable local results, 1 acre consuming on an average 150,000 gallons at one charge of the filter-drains therein.

Improvements in the manufacture of cement. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. December 12, 1873.—No. 4099. The patentee takes spent lime which has been employed in purifying gas, and adds thereto from 15 to 25 per cent of ordinary clay, in which the siliceous ingredient preponderates.

An improved explosive compound or gunpowder. Joseph Fenton, Colchester, Essex. December 17, 1873.—No. 4148. This white gunpowder is composed of yellow prussiate of potash, loaf-sugar, and chlorate of potash, which are ground fine, and then kneaded to the consistency of dough, after which the compound is dried and passed through sieves of various sizes to obtain different sized grains. This gunpowder is made without any risk, and is more powerful than ordinary powder.

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Vol. XXX. No. 771.

ON THE
PREPARATION OF ARTIFICIAL ALIZARIN.
By ADOLPH OTT.

There being very little known on the manufacture of artificial alizarin, I suppose that a detailed description of the process employed will be welcome. Of the different methods proposed for the transformation of the anthracen into alizarin, manufacturers now follow generally that which is described in the patent of Graebe, Liebermann, and Caro, dated June 25, 1869. It is based upon the oxidation of anthracen to anthrachinon, the treatment of the anthrachinon with sulphuric acid in order to convert it into the bisulpho-combination, and the melting of the corresponding soda salt with hydrate of soda, whereby alizarin is formed.

Preparation of the Anthrachinon.

With regard to the conversion of the anthracen into anthrachinon, bichromate of potassa and sulphuric acid are generally used; many manufacturers employ also some nitric acid, especially towards the end of the operation. Anthracen and bichromate are intimately mixed together, the sulphuric acid (in dilution) being only gradually added. The operation is conducted in tubs lined with lead, and with the use of steam. By the addition of acetic acid to the mixture, the reaction takes place with less loss of substance, but it is probably only employed when it can be got cheaply. In case acetic acid is used in conjunction with oil of vitriol, the proportions are of course subject to a change. On a small scale I have employed the following process:—1 part of anthracen was mixed with 2½ parts of bichromate of potassa, and to this 4 parts of wood-vinegar were added. After this mixture had been heated for some time, 6 parts of oil of vitriol, diluted with twice their volume of water, were gradually poured in. The operation was conducted on the water-bath, until no further reaction was recognisable. The yield equalled nearly the theoretical one. M. Nienhaus, in Zurich, informs me that he has successfully used the following process:—100 parts of anthracen were mixed with 25 parts of bichromate of potassa, 12 parts of nitric acid of 1·05 sp. gr. being added. A smeary mass resulted, which, if brought into a moment's contact with fuming nitric acid, was rendered granular, like anthrachinon produced in the ordinary manner. In contact with sulphuric acid, the smeary mass developed nitric acid gas.

The anthrachinon prepared from commercial anthracen requires a preliminary purification. To this end, the crude product is dissolved at 70° C. in concentrated oil of vitriol, and left in contact with it until sulphurous acid gas ceases to be disengaged. This operation is conducted in cast-iron kettles. It is then precipitated by water, collected, thoroughly washed, pressed out, and dried at a temperature of 50° C. Thus purified, it forms a greenish grey, impalpable powder.

Preparation of Alizarin.

The first step now consists in the making of the bisulph-anthrachinonic acid—

$$C_{14}H_6O_2\left\{\begin{matrix}SO_3H\\SO_3H\end{matrix}\right.$$

which is obtained by dissolving 1 part of anthrachinon in 4 to 5 parts of fuming oil of vitriol, and heating of the mixture to a temperature of from 270° to 290° C. Hereby it is important to proceed as quickly as possible, because otherwise a large amount of phthalic acid is formed. On a large scale, the operation is completed in two hours. It is best conducted in cast-iron vessels. Since at so high a temperature considerable quantities of anthrachinon sublime, the vessels are best set in connection with a wooden chamber by means of pipes; there all the anthrachinon is deposited that would otherwise be lost. It has been stated that by the addition of from 1 to 2 per cent of nitric acid, the sublimation of the anthrachinon could be avoided, but this I have found not to be the case. The final product consists of a black, pitch-like, and (if cool) solid mass. This is well exhausted with a large quantity of boiling water; the liquid is then filtered, and the clear slightly yellowish coloured liquid is saturated with chalk, whereby a lime-salt of the bisulpho-acid is formed, sulphate of lime being precipitated. The filtered solution, which now presents a brownish red colour, is decomposed with carbonate of soda, whereby at a moderate heat granular carbonate of lime deposits. The liquid now bears great resemblance to a decoction of Brazil wood. It is syphoned off, evaporated to 20° Baumé, and allowed to cool. What then settles yields alizarin with a bluish shade *(Alizarin mit Blaustich)*, and the liquid such with a yellowish tint *(Alizarin mit Gelbstich)*. Manufacturers believe that the former consists of the bisulpho-salt, the latter of the monosulpho-salt, but it is more probable that the yellow tint is due to a distinct yellow colouring matter.

In order to convert the sulpho-salt into alizarin, it is brought to a certain specific gravity, and is then treated with hydrate of soda, whereby the following reaction ensues:—

$$C_{14}H_6O_2\left\{\begin{matrix}SO_3Na\\SO_3Na\end{matrix}\right\}+2NaOH=$$
$$=C_{16}H_6O_2\left\{\begin{matrix}HO\\HO\end{matrix}\right\}+2(Na_2SO_3)$$

The operation is conducted in cast-iron vessels provided with stirrers, and at a temperature of from 170° to 200° C. The kettles are set into oil-baths, the arms of the stirrers presenting the form of plough-shares; the solid hydrate of soda is only gradually added. If the temperature is exceeded, a re-formation of a part of the bisulpho-salt into anthrachinon, or even into anthracen, can readily take place. These substances are then generally found deposited on the lower part of the cover. As to the time of the operation, it is dependent, of course, upon the quantity of the materials taken, and other conditions, but it seems always to require several days. At the time when the blue colour of the melting mass passes over into a violet-blue, a sample is withdrawn from time to time, and dissolved in water. To the liquid a few drops of sulphuric acid are added. If large quantities of flocculæ separate, it is a sign that the operation is almost or quite complete. The withdrawing of samples is therefore repeated during short intervals. When it is thought that the process is terminated, the contents are dissolved in water, the liquid is poured in wooden tubs, and the alizarin precipitated by means of hydrochloric or sulphuric acid. The precipitate is then washed well in a filter-press; and in order that the alizarin, which now presents itself in very fine flocculæ, remains suspended, it is subjected to agitation in a special apparatus, and then brought into commerce either as *pate* of 15 per cent or as *pate* of 10 per cent.

Berne, Switzerland.

ON A NEW CONSTRUCTION OF A BAROMETER.
By CHARLES H. GIMINGHAM

The following is a simple method of constructing an accurate barometer for scientific purposes, and is specially adapted to be used in conjunction with the Sprengel mercury air-pump. The advantage consists in the construction of the air trap being so easy that it affords the amateur instrument maker a means by which he can manufacture a very perfect barometer at pleasure.

A piece of tubing (any kind of glass will do, providing it will stand heating without fracture) 8 or 10 inches long and about 10 millimetres internal diameter; this must be thoroughly cleaned and one end sealed and rounded off in the blowpipe flame, as shown at *a*, Fig. 1. At about 3 inches from this sealed end, the tube is heated in rather a broad blast, turning slowly and evenly all the time; when red-hot and quite soft, remove from the flame and draw out until the bore in the centre (*b*, Fig. 1) is about 1 millimetre in diameter. The tube is now filled with mercury up to *c*, placed inside another tube, and the whole length from *a* to *c* boiled, piece at a time, over a Bunsen's lamp, till no more specks of air are seen between the mercury and the glass. This boiling operation is rather tedious, and generally takes from ¼ to ¾ of an hour. As soon as the boiling is finished, which must be done with great care, and the tube cool, it is cut at *b* with a sharp file, a little mercury forced out by expansion, and when again cool the aperture can be contracted to a capillary bore.

Fig. 4.

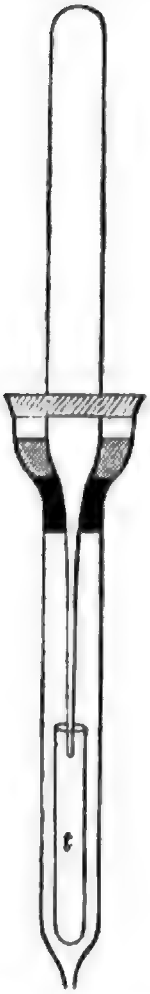


Fig. 3.

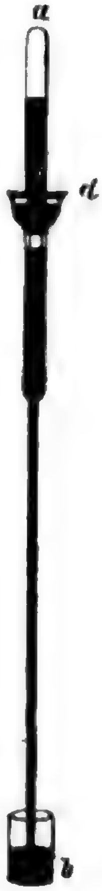


Fig. 2.

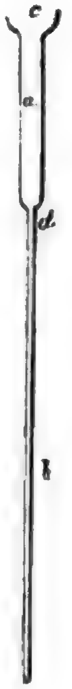
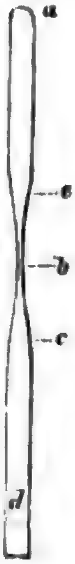


Fig. 1.



The second part is shown in Fig. 2. *a* is made from the piece of tube *d* (Fig. 1) cut off after boiling *a c*. To form the cup *c* (Fig. 2) the end is closed and a small thick bulb blown, the bottom of which is heated till quite flat, then blown out rather suddenly; the large thin bulb thus made is broken off and the edge of the cup fused round with a pointed flame. A piece of tube of smaller bore is joined on to *a*, and the end cut off so that when the barometer is put together, its length from *a* to *b* (Fig. 3) shall be about 33 inches; then by placing the proper height of mercury in the reservoir the normal pressure can be arranged to stand in the centre of the top part (*a d*).

A plain india-rubber collar is now cut out with cork borers, which is easily done by wetting with caustic potash; it must be made to fit loosely in the tube *a* (Fig. 2) so that when pressed up to the shoulder (*e*, Fig. 1) it will fit tight and be conical in shape. Before placing the collar on the tube it is heated till quite soft, and the surface inside and out slightly decomposed; this will make the adherence to the glass very perfect.

The second part (Fig. 2) must now be carefully filled with mercury up the cup *c*, best done by suction with the tube in a slanting position, as very little air is enclosed this way, between the mercury and the glass; it is difficult to bring the mercury to more than within a couple of inches of the top by suction, but the wide part (*a*) is easily filled without enclosing air, by means of a long-necked funnel kept below the surface of the mercury. The tube is kept full by pressing the lower end on a piece of india-rubber.

The top part is inverted in the cup, having first expanded the mercury till it oozes out of the capillary aperture. The collar is pressed in as tight as possible, which will cause some mercury to pass into the cup. This must be allowed to remain there in order to make the joint sound, and a ring of cork fitted to the top of the cup to serve the double purpose of keeping the mercury in its place and supporting the top of the barometer. A section of the trap thus formed is shown in Fig. 4.

An extra safeguard against air passing up to the top of the barometer consists in placing a small cup made of a piece of tube sealed at one end over the point of the trap before putting the two parts together (*t*, Fig. 4).

Of course it is well known that all good barometers have a trap of this description which is always blown in the tube. To make a compound joint like this requires very considerable skill at glass-blowing, the great difficulty being to get the joint to stand the long-continued boiling of the mercury; it has been in this part of the operation that most of my blown traps have cracked, and after repeated trials I thought of the plan I have been endeavouring to describe, and can testify to its giving results highly satisfactory, having had a barometer made in this way at work by the side of the gauge of Mr. Crookes's mercury pump for many months.

It may be well to give one or two hints before conclusion with regard to making the joint (*d*, Fig. 2). The tubes *a* and *b* must be of the same glass: I generally use the English lead glass; it is easy to work, and answers quite well. The tube *a* (Fig. 2) after blowing the cup *c* is cut off at about *c* (Fig. 1), so as to leave the aperture about two-thirds of the real diameter of the tube. One end of *b* (Fig. 2) is then expanded to the same size, by making it soft and pressing it out with an iron wire, which must be made hot before touching the glass or the latter will crack. The two are now heated at the tip of a pointed flame and put together; the joint has now to be thoroughly fused all round with a very small pointed flame, but only directing the flame to one part at a time. The glass will be driven in at each point when the flame is directed on it; but this indentation will be expanded again each time by gently blowing in at *c* (Fig. 2) having previously closed the end of *b* with a small piece of cork; when the joint is finished it is well to keep it in a smoky gas flame for some time, till thickly covered with lamp-black, and then allowed to cool.

ON THE COMPOSITION OF TEA AND TEA-SOILS FROM CACHAR.*

By Professor HODGES, M.D., F.C.S.

Notwithstanding the important place occupied by the tea-plant in the dietary of so large a portion of the world, its chemical examination has attracted comparatively but little attention. We owe to Peligot and Mulder the most valuable investigations which have been made in conection with it; and more recently we have been supplied with some analyses of the ash of teas from the laboratory of Professor Horsford, while Wanklyn and Allen have lately contributed many facts of great value in reference to the examination of the tea of commerce and the detection of adulteration.

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* Read before the British Association, Belfast Meeting, Section B.

Some time ago Professor Zöller read before the Physico-Medical Society of Erlangen a paper on the chemical investigation of a Himalaya tea (*Repertorium für Pharmacie*, Band xx., heft 8), which possessed peculiar value, from the circumstance that the specimen examined might be regarded as consisting of genuine tea without any foreign admixture, having been received from the growers by the late Baron von Liebig. Professor Zöller's investigations confirmed the correctness of observations which he had formerly made respecting the influence which the age of the leaves of plants exercised on the composition of the ash, that while young leaves are rich in potash and phosphoric acid, and poor in lime and silica, the amount of lime and silica in the ash increases with the age of the plant. As the best qualities of tea are known to consist, as I shall presently show, merely of the very young shoots of the plant, the estimation of the amount of potash, phosphoric acid, lime, and silica, may usefully, as he suggested, be employed in enabling us to judge of the quality of a specimen of tea. This opinion he found confirmed by the examination of the specimen of Himalayan tea.

100 parts of the ash of this tea consisted of:—

Potash	39·22
Soda	0·65
Magnesia	6·47
Lime	4·24
Oxide of iron	4·38
Protoxide of manganese	1·03
Phosphoric acid	14·55
Sulphuric acid	trace
Chlorine	0·81
Silica, acid, and sand	4·35
Carbonic acid	24·30
	100·00

The richness of the tea-ash in potash and phosphoric acid, showing that the tea had been prepared from young leaves, suggested that the amount of leaves, soluble in water, and of nitrogen, and also probably of theine, would be large. These anticipations were confimed by the investigations. The extract obtained by treating the leaves with boiling water weighed 36·38 per cent and the nitrogen 5·38 per cent, while the theine amounted to 4·95 per cent of the air-dried leaves.

Some time ago I had an opportunity of submitting to examination specimens of tea grown in Cachar, under the superintendence of Samuel Davidson, Esq., formerly of Belfast, and also a specimen of fine Cachar tea forwarded to me from the same district by Dr. Joseph Nelson. Mr. Davidson's specimens were taken from the fields in August and were carefully enclosed in tin-foil, and may therefore be regarded as representing genuine, unmixed specimens of Indian tea. Mr. Davidson also kindly supplied the following history of the crop from which the specimens were taken. "The leaves were taken from plants in their 7th season and consisted of the young shoots from which tea is manufactured, viz. the bud, and first, second, and third leaves, down the stem. In none of the samples were there old leaves or actual wood. A shoot with this number of leaves is usually the growth of about twelve days after the bud has got started to grow. The indigenous sample is from the variety of the plant which was originally found growing wild in the jungles of these districts. It is, I should think, the true *Thea viridis*. It is a very large growing plant, almost a tree, and its leaves when full grown are very large and succulent. It yields by far the best quality of tea. The other sample was from a hybrid plant. This is supposed to be a true hybrid between the indigenous and China varieties, and certainly partakes very much of the peculiarities of both varieties. The China plant is the variety, which I think is the correct *Thea Bohea* originally imported direct from China. It is a miserable, small-growing, stunted plant compared to the indigenous, the full-grown leaves being only about 2 inches long, and the tea is inferior. The hybrid gives a good strong tea, and is a hardier plant than the indigenous, and so is very much liked, but the more closely it approaches to the indigenous it is the more highly prized." The specimens received by me had been mainly dried in heated rooms. The produce of the crop was estimated at 400 lbs. of dried tea per English acre.

It is so seldom that we are able to obtain any precise account of the history of the specimens of tea and other foreign productions which have been submitted to chemical examination that Mr. Davidson's report possesses especial importance.

One hundred parts of each variety of the tea gave me the following results:—

	Indigenous.	Hybrid.
Moisture	16·06	16·20
Organic matters	78·81	78·98
Mineral matters	5·13	4·82
	100·00	100·00
Nitrogen in the dried tea	4·74	2·81

The ash of each respectively, consisted of—

	Indigenous.	Hybrid.
Potash	35·200	37·010
Soda	4·328	14·435
Chlorine	3·513	2·620
Sulphuric acid	5·040	6·322
Phosphoric acid	18·030	9·180
Oxide of iron	2·493	2·463
Protoxide of manganese	1·024	0·800
Lime	8·986	5·533
Magnesia	4·396	5·910
Sand and silica	0·500	1·300
Charcoal	2·900	1·830
Carbonic acid	13·590	12·600
	100·000	100·000

I was also enabled to submit to examination specimens of the soil and subsoil from the field on which the tea had been grown. Both soils were of a reddish colour, and in fine powder. The subsoil, which was taken 1 foot 6 inches below the surface, being rather deeper in colour than the soil. A textural examination of the specimens was made according to the method which I have described in my work on "Chemistry for Farmers," and gave the following result:—

100 parts of each respectively were found to consist of-

	Soil.	Subsoil.
Sand in fine powder	71·5	82·5
Clay	28·5	17·5

Carbonate of lime, less than 5 per cent.

Both soils may therefore be described as *sandy loams*.

Chemical Composition.—

100 parts of each respectively consisted of—

	Soil.	Subsoil.
Organic matters	4·75	5·18
Chloride of sodium	0·11	0·35
Potash	0·03	0·03
Oxide of iron	6·00	7·20
Oxide of manganese	trace	trace
Alumina	2·02	3·86
Lime	trace	0·10
Magnesia	0·12	0·05
Sulphuric acid	0·07	0·35
Phosphoric acid	0·05	0·03
Insoluble siliceous matters	64·80	56·50
Moisture	22·20	24·44
Nitrogen, per cent	0·158	0·22

The amount of nitrogen and alkalies in the su will be perceived, exceeds that which was found surface-soil. This, I consider may be owing to the circumstance, that heavy rains (40 inches within four months), had fallen for some time before the specimens were taken.

Another sample of Cachar tea kindly forwarded to me by Dr. Joseph Nelson, was also examined, chiefly for the purpose of ascertaining how far we could rely upon the determination of the amount of matters which are removed by heating tea with boiling water, as indicative of the presence in the tea of commerce of exhausted tea, or of foreign leaves.

100 parts of the specimen were found to contain 4·963 parts of moisture, and the ash amounted to 5 parts. By treating the leaves with boiling water until exhausted of soluble matters, and evaporating the solution to dryness, an extract weighing 42·4 grains was obtained. Determinations of the amount of nitrogen in the leaves as received, and also in the insoluble residue, were made, and while the nitrogen of the original sample amounted to 4·425 per cent, the insoluble residue was found to contain only 2·109 parts, the amount of mineral matters by treatment with water being reduced to 1·56 parts, so that 68 per cent of the total mineral matter of the tea, and about 58 per cent of the nitrogen had been removed in the infusion.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.

(Continued from page 3).

III.—*Mustard.*

Genuine mustard consists of the mixed flour of black and white mustard seeds, without any addition of farina or colouring matter. The black and white mustard exhibit essential differences in their composition, as is seen in the following recent analyses by Dr. Hassall[*] :—

	Brown Mustard. Per cent.	White Mustard. Per cent.
Moisture	4·84	5·36
Fixed oil	35·70	35·78
Myronic acid	4·84	none
Myrosin and albumen	29·54	27·48
Sinopine hydro-sulphocyanate ..	3·59	10·98
Cellulose	16·76	16·29
Ash	4·73	4·11
	100·00	100·00

The myrosin is an albumenoid body, which, in presence of water, acts on the myronic acid and converts it into allyl-sulphocyanate,[†] or volatile oil of mustard, to the presence of which the extreme pungency of mustard after admixture with water is due. It will be seen that myronic acid, the source of the volatile oil, is found only in brown mustard, but the real amount existing is very doubtful, Ludwig and Lange having obtained only 0·2 per cent of potassium myronate from brown mustard.

The usual additions to mustard are foreign farinas (wheat-flour is the most common) for increasing the weight and bulk, turmeric as a colorant, and cayenne for imparting a fictitious strength. Before the new Act came into operation, by far the larger quantity of the mustard sold was largely adulterated, and there are still numerous instances in which "mustard condiment" is sold without acknowledgment of its nature either by label or word of mouth. Regarded merely as a condiment, there can be no harm in selling diluted mustard provided the purchaser is informed of its true nature, but it must not be forgotten that mustard is also a drug or remedy. If a mustard plaster is applied in a case of emergency, or mustard and water given as an emetic for accidental poisoning, and the remedy refuses to act because of its dilution by flour, most serious consequences may ensue. Mustard is a common household remedy, and its timely application, while awaiting the arrival of the medical man, is often of great importance; but it is worse than useless if mixed with large and indefinite proportions of inert bodies, and the pretended necessity for the use of these is now fully disproved by the fact that many mustard manufacturers advertise genuine unmixed mustard of various qualities and prices, from 9d. per lb., the price being dependent on the proportion of the black and white seeds present.[*]

The detection of wheat or other foreign farina in mustard presents no difficulty, as mustard contains no starch naturally, and therefore the production of a blue colour, on adding solution of iodine to the cold aqueous infusion of the sample, infallibly indicates adulteration. The kind of starch present is of course ascertained by the microscope, which also gives a rough idea of its relative amount, but it seems very desirable, when possible, to ascertain and certify to the percentage of adulteration, and this can be done with a fair approach to accuracy in the following manner:—

It will be seen from the above analyses by Hassall that both brown and white mustard farinas contain a large proportion of fixed oil, and the amount is practically the same in both varieties. The estimations of fixed oil were made by Hassall by exhaustion with ether, and in various commercial mixtures of the white and brown mustards he found by the same process quantities varying from 33·97 to 36·75 per cent, the average being 35·53. I have myself, by exhaustion of genuine mustards with benzol, found a mean of 35·1.[†]

The extent of the adulteration of any sample of mustard can therefore be very fairly ascertained by estimation of the percentage of oil. This is done by exhaustion with benzol or ether, of which I prefer the former. 2 grms. of the sample are treated in a flask with about 30 c.c. of commercial benzol, the flask attached to a reversed Liebig's condenser, and the liquid boiled gently, and filtered into a flask after cooling. The process is repeated till the mustard is thoroughly exhausted, when the benzol holding the oil in solution is distilled off, and the residue heated to 130° C. till it ceases to lose weight, when the remaining fixed oil is weighed. If the proportion of oil in genuine mustard is taken at 35 per cent, the percentage of oil in the sample, multiplied by 2·857, will be the percentage of real mustard present.

Some chemists determine the amount of admixture in mustard by estimating the sugar produced by boiling the sample with dilute acid. This method involves the assumption that the flour added is constant in composition; and the fact that glucose is one of the products of the decomposition of myronic acid has been altogether lost sight of.

Turmeric is readily recognised under the microscope by its characteristic structure, and its yellow colour, changed to blue by iodine. It may also be detected with great readiness by the following test:—About 1 grm. of the sample is boiled with methylated spirit, and filtered. The yellow tincture is evaporated in a capsule at a steam heat, and, when concentrated, a small piece of filter-paper (the size of a penny) is immersed in the liquid, the evaporation of which is carried to dryness. The paper is then

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[*] "Food, Water, and Air"; February, 1874.

[†] The change is probably expressed by the equation—

$$\underbrace{K_2C_{20}H_{38}N_2S_4O_{10}}_{\text{Potassium myronate.}} = 2KHSO_4 + 2\underbrace{C_3H_5.CNS}_{\text{Allyl-sulphocyanate.}} + 2\underbrace{C_6H_{12}O_6}_{\text{Glucose.}} + H_2O.$$

[*] It has always seemed to me that the argument is remarkably weak which supposes that the low price of an article gives the purchaser sufficient information of its quality, and that he must know that it could not be pure at the price. Unless he is in the habit of buying the article, or has had his attention directed to the usual price, the purchaser is often quite ignorant of it. Exclusive of public analysts, how many of the readers of the Chemical News know the market price of mustard, lard, coffee, cocoa, &c.?—A. H. A.

[†] The constancy of these results throws great doubt on the statement that one object in the addition of wheat-flour is to dry up the mustard and prevent the necessity of extracting a portion of the fixed oil. At any rate, the proportion of oil in a sample of adulterated mustard is a fair criterion of the amount of admixture, as it is just such mixed mustard which does not require the removal of any of the oil.

moistened with a saturated aqueous solution of boric acid, when, after re-evaporating, the paper will acquire a reddish colour if turmeric be present. As a further proof, caustic potassa or soda should be dropped on it, when a very beautiful series of colours will be produced, green and purple being the most prominent. On adding hydrochloric acid a red colour is produced, which is again turned green and blue on addition of excess of alkali. The colours are very vivid and characteristic, pure mustard giving no such result.*

The fluorescence of the tincture also serves for the detection of turmeric. It seems very questionable whether turmeric is ever mixed with mustard in sufficient quantity appreciably to affect the weight or bulk of the article; but its recognition is sometimes important as it is not added to genuine mustard, and therefore adulteration of some sort may be inferred from its presence.

Gamboge is said to be sometimes used for colouring mustard. It does not give the turmeric reaction, but is turned red by alkali, and restored to yellow by addition of acid. The purgative properties of gamboge render its employment as a colouring matter very undesirable.

Cayenne Pepper, or Capsicum, is often added to adulterated mustard to increase its pungency. It is recognisable by the microscope, and also very readily in the following manner:—The mustard is treated with spirit as in testing for turmeric, the tincture is evaporated, and the extract *tasted*, when the pungent biting flavour of cayenne will be readily perceived. A still more striking test is to heat the dry alcoholic extract and smell the fumes, when, if cayenne is present, an overpowering heat in the lungs, irresistibly compelling coughing, will be perceived. The fumes from pure mustard are not irritating, but ginger produces a somewhat similar effect.

"*Terra Alba*," or *Plaster of Paris*, was at one time used to a considerable extent for adulterating mustard. Its presence would be detected on estimating the ash, which is always below 5 per cent in mustard free from mineral adulterations. *Chalk* is said to have been employed as an adulterant of mustard, and *chrome-yellow* for colouring.

"*Charlock*," or wild mustard seeds, are sometimes used. Their employment can scarcely be called an adulteration, and their detection is extremely difficult, even with the microscope.

(To be continued.)

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY

IN THE LABORATORY OF THE

UNIVERSITY OF VIRGINIA.

(No. III.)

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(Continued from vol. xxviii., page 272).

(1). *Analyses of the Ashes of Virginia Tobaccos, with Determinations of Nicotine and of Total Nitrogen.* By Mr. J. R. McD. Irby, of New Orleans, La., and Mr. J. Alston Cabell, of Richmond, Va.

Notwithstanding the prominent position of Virginia in the production of tobacco,† there are hitherto, so far as I am aware, no results on record of any chemical examination of the ash of the plant as here cultivated, and, in the statements of Schlösing as to the relative amounts of nicotine contained in various kinds of tobacco, that from Virginia forms but a single head, whereas several varieties, of quite different commercial characters and uses, are produced within the State. Hence it has seemed a matter of interest to obtain good typical specimens and submit them to careful examination, and this has been done under my direction in this Laboratory during the past winter by the two gentlemen above named.

I am indebted for the specimens employed to the kindness of Walter K. Martin, Esq., of Richmond, Va., whose information as to the crop in this State is both extensive and accurate. Of the following samples, two were of light-, one of medium brown-, and three of dark-coloured tobacco; all were in the "leaf" state, made up in the usual bundles, free from stalk, but retaining midrib.

No. 1, light yellow tobacco—"coal-cured wrappers" for cigars—cultivated in the counties of Virginia and North Carolina adjacent to Danville, Va. Average length of bundle = 18 inches. Average weight of bundle = 2·65 ozs. Avoir.

No. 2, light yellow—"fine smoking"—from counties of Virginia and North Caroline adjacent to Danville, Va. Average length of bundle = 15½ inches. Average weight of bundle = 2·50 ozs.

No. 3, medium brown colour—"sweet fillers" for cigars—from counties of Louisa, Caroline, Hanover, Goochland, and Fluvanna, Va. Average length of bundle = 19 inches. Average weight of bundle = 2·82 ozs.

No. 4, dark—"Austrian cigar wrappers" (also used in Italy for same purpose)—from Charlotte Co., Va. (similar tobacco produced in Halifax, Prince Edward, Nottoway, and Lunenberg Counties). Average length of bundle = 21 inches. Average weight of bundle = 4·00 ozs.

No. 5, dark—"English shipping"—cultivated in Amelia, Powhatan, Cumberland, and Prince Edward Counties, Va. Average length of bundle = 22 inches. Average weight of bundle = 4·58 ozs.

No. 6, dark—"exported to France for snuff" (tobacco of similar quality also largely shipped to Germany)—from Campbell and Bedford Counties, Va. Average length of bundle = 20 inches. Average weight of bundle = 5·37 ozs.

These specimens by no means cover all the commercial grades produced in Virginia, nor all the distinctive agricultural districts concerned in the production, but they represent some of the most important and characteristic varieties.

The method of analysis adopted was uniformly applied to all the samples, of which Mr. Irby examined Nos. 2, 3, and 5, and Mr. Cabell Nos. 1, 4, and 6. The air-dried tobacco, representing as fairly as possible all parts of the bundles taken, was in each case ground to powder, this well mixed, the different portions needed weighed off, and the residue kept in a well-stoppered bottle to be drawn from as required. It was very carefully burned at the lowest possible temperature in a partially-covered porcelain crucible suspended within one of sheet-iron, the latter serving the purpose of a hot-air bath, the heat being very gradually applied. The amount of crude ash so obtained, not entirely free from remains of charcoal, was found as follows:—

Table I.—In 100 parts air-dried tobacco.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Crude ash ..	11·803	15·394	18·518	16·313	18·177	15·905

From one portion of this crude ash carbon dioxide was determined, and from another a solution was obtained by careful exhaustion with water and dilute hydrochloric acid to be used in the principal analysis,—the insoluble residue, consisting of extraneous siliceous matter (sand, &c.) and a little charcoal, being weighed. The results were the following:—

Table II.—In 100 parts crude ash.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6
Pure ash (portion dissolved by HCl) ..	70·735	63·173	60·935	84·401	64·532	66·662
Insoluble residue (sand and charcoal)	5·275	14·694	16·978	7·916	8·819	8·969
Carbon dioxide	23·990	22·133	22·087	7·683	26·649	24·369
	100·000	100·000	100·000	100·000	100·000	100·000

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* I give this new modification of the boric acid reaction in full, as experience has proved it to be exceedingly delicate, and applicable to the detection of turmeric in cases where its recognition is less easy than in mustard.

† The United States Census of 1870 shows that Virginia afforded in that year 37,086,364 lbs., ranking second only to Kentucky among the States, while in 1860, the year before the civil war, Virginia was first and Kentucky second in reference to this crop.

No. 4 was probably more strongly heated after burning than the others, much CO_2 being expelled.

A separate portion of crude ash was treated with nitric acid in order to get a solution in which to determine chlorine, and independent experiments were made to prove (as they did) that no appreciable loss of chlorides had occurred by volatilisation, or of sulphates by reduction to sulphides. The general analysis, conducted by the usual methods, yielded—

TABLE III.—In 100 parts pure ash (including Fe_2O_3 and Al_2O_3).

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
SiO_2 ..	1·388	2·202	2·509	1·073	0·846	1·932
Cl	2·242	2·696	4·263	2·358	3·679	1·109
SO_3 ..	9·587	3·231	3·630	5·416	4·602	5·466
P_2O_5 ..	3·512	1·235	3·372	2·219	4·408	4·379
K_2O ..	39·500	26·728	36·355	32·170	39·888	31·894
Na_2O ..	2·741	1·121	3·150	6·584	1·318	1·269
CaO ..	31·123	47·273	29·424	32·561	37·359	39·682
MgO ..	8·578	10·103	13·889	14·692	6·369	8·475
Fe_2O_3 and Al_2O_3 ..	1·329	5·411[*]	3·408	2·927	1·531	5·794
	100·000	100·000	100·000	100·000	100·000	100·000

[*] By difference.

Assuming the alumina and most, at any rate, of the ferric oxide to have been derived from adherent soil or dust, the above analyses have been re-calculated, excluding these two constituents; hence are obtained the figures of

TABLE IV.—In 100 parts pure ash (exclusive of Fe_2O_3 and Al_2O_3).

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
SiO_2 ..	1·407	2·328	2·597	1·105	0·859	2·004
Cl	2·273	2·850	4·413	2·428	3·737	1·174
SO_3 ..	9·710	3·416	3·757	5·581	4·674	5·803
P_2O_5 ..	3·560	1·306	3·490	2·286	4·478	4·658
K_2O ..	40·040	28·257	37·641	33·139	40·509	33·870
Na_2O ..	2·778	1·185	3·261	6·789	1·339	1·353
CaO ..	31·538	49·077	30·462	33·540	37·940	42·140
MgO ..	8·694	10·681	14·379	15·132	6·461	8·998
	100·000	100·000	100·000	100·000	100·000	100·000

The total nitrogen was determined for each sample by Dumas's method, and also, for comparison, by combustion with soda-lime, it being known that the latter process would yield results below the truth, but how far below it seemed well to notice. The nicotine was determined volumetrically by means of a standard solution of potassio-mercuric iodide, as recommended by Zinoffsky,[*] this process being carefully compared in one instance with that formerly adopted by Schlösing. Each specimen of the air-dried tobacco, as used for analysis, was also carefully dried by prolonged heating at 100° C., and the water thus determined. These results are given in

TABLE V.—In 100 parts air-dried tobacco.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6
Nitrogen, by absolute method	2·031	2·587	3·290	5·190	4·620	4·748
Nitrogen, by combustion with soda-lime	1·978	1·552	1·950	4·333	3·920	4·420
Nicotine, by potassio-mercuric iodide	3·062	3·550	4·660	6·382	5·350	8·002
Nicotine, by method of Schlösing	—	3·580	—	—	—	—
Water, by drying at 100° C...	7·911	1·001	11·671	9·932	13·744	9·707

It is remarkable that so small an amount of water was driven off from No. 2 at 100° C.; this specimen, however, was obviously very dry as received, the leaves cracking and crumbling to pieces very easily on handling. If now the water thus found be deducted from the weight of air-dried tobacco, and the pure ash (deducting sand, charcoal, CO_2, Al_2O_3, and Fe_2O_3) and the nitrogen as determined by Dumas's method be alone considered, we have as the percentage of ash, nitrogen, and nicotine for the dry plant, the following:—

TABLE VI.—In 100 parts tobacco dried at 100° C.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Mean.
Total ash (pure) ..	8·043	9·292	12·340	14·839	13·391	11·062	11·645
Total nitrogen ..	3·183	2·633	3·725	5·762	5·333	5·258	4·310
Nicotine..	3·325	3·586	5·276	7·086	6·202	8·862	5·723

Subtracting from the total nitrogen as thus stated the amount of this element represented by the nicotine in each case, we find the percentage of nitrogen in other forms (albumenoids and nitrates) than that of the alkaloid—

TABLE VII.—In 100 parts tobacco dried at 100° C.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Mean.
Nitrogen in other forms than that of nicotine	2·608	2·013	2·813	4·538	4·262	3·727	3·327

The average percentage composition of the pure ash (for the six specimens), obtained by taking the mean of the figures in each line of Table IV., is as follows:—

TABLE VIII.

SiO_2	1·717
Cl	2·812
SO_3	5·490
P_2O_5	3·296
K_2O	35·576
Na_2O	2·784
CaO	37·600
MgO	10·725
	100·000

It appears from the above results that the average total amount of pure ash, referred to material dried at 100° C., is less than that recorded for European (including Turkish) tobacco, the average for ten specimens of the latter *air-dried* being 15·50 per cent, and for three specimens dried at 100° C. 16·82[*] per cent; and also falls below the average for the tobacco of Connecticut and Massachusetts, given at 16·56 per cent (mean of twelve specimens) by Prof. S. W. Johnson,[†] and at 16·32 per cent (mean of five specimens) by E. S. Breidenbaugh.[‡] On the other hand, the average for thirty specimens of Kentucky tobacco[‖]—12·83 per cent—agrees much more nearly with these Virginia results. If it be allowable to draw any conclusion from the averages of individual figures differing so widely among themselves, the question suggests itself whether the relatively rapid growth of the plant in the shorter season of the more northern regions of production, and perhaps less complete maturity of the tissues at cutting, may be attended with an habitually larger percentage of mineral matter.

As regards the relative proportion of the different mineral ingredients, the results agree generally with those above referred to for tobacco of other localities, especially as to the more important substances, as will be seen from Table IX., the agreement in the case of the European analyses being a good deal affected by a probable excess of silica in these (due to burning at too high a temperature), and the very abnormal figures for the alkalies in one or two of the analyses (that of the Turkish tobacco showing but a fraction of 1 per cent of K_2O, while one of tobacco from the Palatinate gives over 17 per cent of Na_2O!). There is perhaps shown a tendency to rather more lime and magnesia in the Virginia than the Kentucky samples, and in the latter as compared with those from New England. The large proportion borne by the basic to the acid constituents of the ash of course illustrates the well-known large extent to which salts of organic acids occur in tobacco.

That the results as regards mineral matter vary a good deal, even for the product of a single locality, is shown by a few experiments made with *single whole leaves* taken from the *same bundle* of Virginia tobacco,—determining

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[*] *Chem. Centralblatt*, March 5, 1873, s. 153

[*] E. Wolff, "Ashen-Analysen v. Landw. Product u.s.w.," Berlin, 1871, ss. 112-3.

[†] "Ann. Rep. of Conn. Board of Agric.," quoted in *Journ. Chem. Soc.*, March, 1874, p. 286.

[‡] *American Chemist*, February, 1873, p. 286. (These specimens probably form a part of those referred to by Prof. Johnson).

[‖] Dr. Peter (quoted by Prof. S. W. Johnson), *loc. cit.*

TABLE IX.

	Average for Tobacco from			
	Virginia (six specimens).	Kentucky (thirty specimens).	New England (twelve specimens).	Europe (including Turkey) (thirteen specimens).*
SiO_2 ..	1·717	2·728	0·845	10·292
Cl ..	2·812	3·741	9·360†	4·920
SO_3 ..	5·490	4·209	6·582	4·304
P_2O_5 ..	3·296	4·988	3·563	3·217
K_2O ..	35·576	37·568	34·964	18·008
Na_2O ..	2·784	2·105	1·993	4·289
CaO ..	37·600	35·308	34·481	43·511
MgO ..	10·725	9·353	8·212	11·459
	100·000	100·000	100·000	100·000

simply the total ash and one or two principal constituents. Thus—

	Per cent of ash (free from CO_2, charcoal, and sand.
1 leaf (A), dried at 100° C., gave	11·790
1 „ (B), „ „ „	12·417
1 „ (C), „ „ „	11·875
1 „ (D), „ „ „	11·817

and in the above amounts of ash there was found—

A ..	3·434	of CaO and	5·428	of K_2O
B ..	4·546	„ „	4·046	„
C ..	3·619	„ „	5·280	„
D ..	4·671	„ „	3·758	„

Very possibly these differences may depend in part upon the different stages of maturity reached by the individual leaves before cutting.

The variation of the several ash analyses, even of the plant from neighbouring parts of the State, does not seem to leave room for tracing any connection with the geological conditions of growth. An apparent tendency to larger percentage of phosphates in the heavy, dark, shipping tobaccos as compared with those of fine light colour suitable for the better class of cigars may probably be connected with the coarse rank growth and larger proportion of nitrogenous matter which the former exhibit.

As regards the amount of nitrogen and of nicotine in the different specimens, the well-known occurrence of these constituents in larger proportion in the coarse as compared with the finer tobaccos is clearly seen. An examination of the figures in Tables VI. and VII. shows that the nitrogen of the nicotine represents a fraction of the total nitrogen present, varying in each case, but less so than might perhaps have been expected.

TABLE X.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Mean.
Relative amounts of nitrogen occurring as nicotine, compared to total nitrogen = 100 ..	18·2	23·6	24·5	21·3	20·1	28·0	22·8

The amount of nicotine afforded by No. 6 is very large—somewhat larger than of the figures quoted from the results of Schlösing.

(To be continued).

NOTICES OF BOOKS.

Tea, Coffee, and Cocoa Analysis. By J. ALFRED WANKLYN. London: Trübner and Co.

THIS work is another of the series of manuals which are gradually rendering the analysis of food, and the detection of its adulterations, simple and certain. For the assay of teas, the author, following up the indications afforded by Peligot, depends chiefly on a determination of the amount of matter capable of extraction by boiling water. It is found that the extract, evaporated to dryness and weighed, yields results constant, and agreeing with the amount found by weighing the leaves before and after extraction. With the aid of the directions given, the entire operation may be performed within two hours. It is, however, pointed out that the extract of genuine teas may range from 32 to 50 per cent. In samples adulterated with previously extracted and re-dried leaves—a very common form of adulteration—the ash is not merely less in total quantity, but different in composition. One-half of the ash of a sample of genuine tea is soluble in water; whilst the ash of spent tea yields, according to Mr. Allen, only 0·5 per cent of soluble salts. Genuine teas rarely yield so little as 5 per cent of total ash, and rarely so much as 6 per cent. The presence of an occasional grain of sand is unavoidable in an agricultural product collected on the large scale, and, as the author justly remarks, should not be considered as an adulteration. Genuine tea is rich in nitrogen to an extent rarely met with in leaves. Hence, where the presence of spurious leaves is probable, a determination of nitrogen by combustion (Gay-Lussac's method), or a determination of "free" and "albumenoid" ammonia, as described in Mr. Wanklyn's "Water Analysis," is recommended. A normal percentage of ash, a considerable part of which is sand (or magnetic oxide of iron) is rightly pronounced strong evidence of sophistication. Where the ash, on the other hand, much exceeds 6 per cent, the author directs that a large quantity should be boiled in excess of water, and the sand, &c., estimated by subsidence, washing, and ignition. The quantitative determination of theine, he considers, will require much improvement and simplification before it can yield available data. On the vexed question of "facing," and the extent to which, if at all, it should be permitted, Mr. Wanklyn is silent.

The quantitative examination of coffee may perhaps be pronounced less difficult than that of tea. The facts upon which the analysis of coffee is based are that it contains no starch, that when roasted its percentage of sugar ranges from 0·0 to 1·14, and that its ash is free from soda. The first point enables us to distinguish a whole class of possible adulterants. Chicory, when roasted, contains 12 to 18 per cent of sugar, so that the amount of chicory present in a sample of coffee may be approximately estimated by the copper-reduction test. Thus a mixture of 3 parts coffee and 1 part of chicory would contain at least 3·85 per cent of sugar. A colorimetrical test is also recommended, the tinctorial power of chicory, even at 212°, being three times as great as that of medium roasted coffee. In solutions made at common temperatures the difference is still greater. The ash of chicory, as shown by Mr. Allen, contains a far smaller proportion of soluble salts than does that of coffee.

We agree with Mr. Wanklyn that dealers who sell coffee mixed with chicory should be compelled to declare, approximately, not merely the presence, but the proportion of the root. We differ from him, however, when he considers that the mixing of coffee with chicory is—or rather *was*—demanded by public taste. As a proof that our view is correct, we venture to prophesy that the proposal to have the proportions of the admixture stated will meet with most violent opposition, and that, if it becomes law, dealers will all at once discover that the public had better buy the two articles separately and mix for themselves. We may fairly pronounce this work to be one which no public analyst, chemist, or medical man can safely dispense with.

City of Boston: Fifteenth Annual Report of the Inspector of Milk. 1874.

THE most interesting portion of this official document is naturally the report of the analyst, Mr. J. M. Merrick. Out of thirty-six consecutive samples which he has examined he announces one only as being free from added water. That one contained 15·7 per cent of total solids. Elsewhere he gives his opinion that "milk to be marked pure should have at least 9·3 per cent of *solids not fat.*" If to this we add an average amount of fat, we find the total solids certainly not less than stated by Müller, Eisenstuck, and Wanklyn. Hence Mr. Merrick's extensive experience furnishes additional evidence against the notion, taken up by the recent Parliamentary Committee on the Adulteration of Food, that the total solids of pure milk may fall below 10 per cent. We commend this matter to the especial attention of Mr. Sewell Read and his colleagues.

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* Fe_2O_3 deducted from the results of analysis as given by Wolff, so as to make the figures comparable with those for the American tobaccos.

† This large amount of chlorine, with the small proportion of sodium below, is worthy of notice. Can this be due to manuring with Stassfurt salts of potash?

CORRESPONDENCE.

THE GLOVER TOWER.

To the Editor of the Chemical News.

Sir,—The reporter of the *Moniteur Scientifique*, in his report on the Vienna Exhibition, having stated that the cost of erection and excessive wear and tear on the Glover tower was against its use in the manufacture of sulphuric acid, will you allow me to use the following as an answer to it for the benefit of your readers?

I have at work here a tower which was erected, January, 1868, at a cost of about £450. It has been in constant use from that time till now, and has cost under £70 in repairs. During the same period, it has denitrated and concentrated upwards of 73,000 tons of acid, to a specific gravity of 1·750, entirely by the combustion of 15,400 tons of pyrites, no coal or other fuel being used. The tower is still at full work, and to all appearances will work many years.

I am aware that very much inferior results have been obtained, but the fault has always been in the construction or management of the apparatus, and is not inherent in it.—I am, &c.,

John Glover.

Wallsend-on-Tyne, August 25, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 3, July 20, 1874.

Action of Two Elements of the Current.—J. Bertrand.—Ampère concludes that two parallel currents attract each other when their direction is the same, but repel each other when it is opposite. He generalises this rule by extending to the elements of the current, to which he applies, whatever may be their relative direction, the idea of a movement of the same, or of an opposite kind. Two currents are said to be of the same kind if they both depart from a common perpendicular, or if they mutually approach each other. In adopting this phraseology, it becomes no longer accurate to say that two currents of the same kind attract each other. It is not even exactly true in the case of parallel elements. As the assertion has been re-produced in all works on physics, and is made to serve as a basis for several important explanations, M. Bertrand shows that it is not in harmony with Ampère's law, and undertakes the solution of the following question:—An element of a current being given, to find in one point of space the direction which must be assigned to another element, in order that their mutual action may be attractive, repulsive, or neuter.

Third Note on the Electric Conductivity of Woody Bodies.—Th. du Moncel.—Hard woods part less easily than soft woods with the moisture which they have stored up, and this moisture, after the first superficial drying re-appears at the end of a certain time. On the other hand, when completely desiccated they take up moisture more slowly from the atmosphere than do soft woods. But as this absorption is continual, they become, after a long time, pervaded by a large quantity of moisture, even when kept in a dry place.

Stratifications of Electric Light.—M. Neyreneuf.—Stratifications of the electric light may be obtained under the following circumstances, which render it possible to produce with static electricity inversions of charges as rapid as those given by the use of Ruhmkorff's coil:—Suppose the two condensers of Holtz's machine connected by a Geissler tube instead of communicating by a continuous piece of sheet metal. The machine is then arranged so as to give small sparks, succeeding each other with great rapidity. Two inverse currents will then traverse the Geissler tube, showing very distinct stratification. In order to succeed, even with very long and wide tubes, it is necessary to replace the ordinary small bottles with jars of great size. Those which the author employed had 1873 square centimetres of surface.

Passivity of Iron.—A. Renard.—Iron may be rendered passive in ordinary nitric acid at from 37° to 40° B. by placing a single wire, 0·02 m. in length and 0·001 m. in thickness, in 20 to 30 c.c. of the acid at the temperature of 17°. The iron is at first briskly attacked, but the action ceases spontaneously, the sooner if the wire is moved about, and the metal then becomes passive. If 20 to 30 c.c. of ordinary acid of the same strength be kept at temperatures of from 0° to 5°, several iron wires may be rendered passive by plunging them one by one into the acid, waiting each time till the action has subsided in order to avoid too great a rise of temperature. If the whole mass of iron is plunged at once into the acid the action is too energetic. Temperature has a great influence on the above phenomenon. It is the same with nitric acid of 41° to 45° B., which does not attack iron in the cold, but begins to act if the temperature be raised to a suitable degree. The more water is contained in the acid, the lower is the temperature at which it acts. Iron may also be rendered passive in common nitric acid at from 33° to 36° B., and at temperatures from 17° to 20°, by plunging a wire, 2 centimetres long and 1 millimetre in diameter, into 20 to 30 c.c. of the acid, and pressing it strongly and repeatedly against the side of the glass. With acid of 36° B. this result is produced after two or three contacts; with acid of 33° B. a little more time is requisite. On touching passive iron, immersed in ordinary nitric acid with a platinum wire, the passivity does not cease, as happens with a copper wire. This fact finds its explanation in the following result:—An iron wire, upon which a gold or platinum wire is coiled, is only very slightly attacked when plunged into dilute nitric acid at from 30° to 40° B., and at the temperature of 17°. The iron wire becomes subsequently passive. These experiments are analogous to those of Schœnbein, in which iron became passive when submitted to the action of an electric current, the positive electrode immersed in common nitric acid being of iron.

Action of Chloroform on Sodium-Aceto Ether.—Oppenheim and Pfaff.—Not adapted for abstraction.

Isomeric Compounds, C_2H_4IBr.—C. Friedel.—The author denies the existence of a third isomer of this formula.

Development of Heat Produced by the Contact of Sulphate of Soda with Water, at Temperatures where the Known Hydrates of Sulphate of Soda Cannot Exist, and where this Salt is only Deposited in an Anhydrous State from its Saturated Solution.—M. de Coppet.—The author's recent experiments confirm the conclusion which he formerly drew from studying the congelation of the solution of sulphate of soda (*Annales de*

Chimie et de Physique, 4 series, t. xxv., p. 542), namely, that this solution does not, as is generally thought, contain merely a single modification of sulphate of soda, or a mixture of hydrates of that salt. The relative quantities of the compounds pre-existing in the solutions must be conceived as varying in a continuous manner, as a function of the concentration and of the temperature. The author's own experiments, and those of Rudorff (*Poggendorff's Annalen*, cxlv., p. 599), lead him to think that the same holds good for the solutions of many other salts.

Ethers of Normal Propyl-Glycol.—E. Reboul.—Not adapted for abstraction.

Experiments on the Generation of Proto-Organisms in Media Protected from Atmospheric Germs.—M. Onimus.—The author concludes from his experiments that proto-organisms may be formed and developed in albumenoid liquids protected from the air.

Composition of Permanganate of Potash.—E. J. Maumené.—Phipson and Terreil have maintained that the permanganate of potash, commonly so-called, is merely a bimanganate, and that manganese forms only one acid. Maumené furnishes experimental evidence that the ordinary view is correct.

New Method of Determining Metals and Oxides.—E. J. Maumené.—The main difficulty in determining both metals in the state of oxides and the oxides themselves springs from the readiness with which oxides, when heated to redness in the air, assume varying and uncertain degrees of oxidation. Copper, for instance, if determined in the state of oxide, may be Cu_2O nearly pure if it has been ignited at a high temperature and cooled quickly, or CuO if it has been cooled slowly, and if it has preserved the state of molecular division which it had before ignition. One and the same weight of oxide may, therefore, contain either 88·89 per cent of metal or only 80 per cent, according as it is in one or the other of these extreme cases. This difficulty is sometimes got over by reducing a known weight of the oxide in a current of hydrogen—an operation not without difficulties, and involving loss of time. It is easy to avoid these difficulties. The oxide, as soon as it has been ignited until the filter is destroyed, is moistened with a slight excess of sulphuric acid, and heated with the needful precautions to bring it to the state mO,SO_3, which is very easy. In taking the exact weight of the sulphate a new difficulty appears. The sulphate in a pulverulent state eagerly attracts moisture. To overcome this drawback, it is sufficient to add to the sulphate whilst still hot a known weight of stearic acid, or of any other fatty matter fusible and not volatile between 200° and 300°.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 11, 1874.

This number contains no original chemical matter.

No. 12, 1874.

Assay of Beet-Roots.—M. Corenwinder, in the *Memorial de Lille*, gives the following simple process for recognising the saccharine value of the seed capsules of the beet. All those intended for propagation are plunged into a saline solution at 3·5° (B. ?). The good ones sink, whilst the inferior kinds remain suspended.

Beet-Root and Chemical Manures.—1000 kilos. of nitrate of soda supposed to be pure contain 364·7 kilos. of soda, representing 835·28 kilos. of sulphate of soda. Hence 1000 kilos. of nitrate of soda introduces into the soil materials capable of converting 3758·75 kilos. of sugar into molasses, a fact which explains the unsatisfactory results obtained by sugar manufacturers when this salt has been used. The sulphate of ammonia has not this injurious property.

No. 13, 1874.

Putrefaction Produced on the Exclusion of Air.—M. Paul Bert.—Meat does not oxidise or putrefy in compressed air, though it undergoes changes of colour, texture and flavour. Certain fermentations may be arrested by oxygen at a high pressure. Wine may be prevented from undergoing the acetous fermentation by the action of condensed air.

Electric Conductibility of Woody Substances.—M. du Moncel.

Summary of Experiments made on the Ascending Movements of the Same Liquids in Capillary Tubes and in Spongy Papers.—C. Decharme.—The relative heights, the speed, and the duration of the spontaneous ascending movements of liquids are all different in capillary tubes from what they are in strips of porous paper, the external conditions being the same in both sets of cases.

No. 14, 1874.

Dielectric Constant of Certain Gases.—L. Boltzmann.—

	$\sqrt{\mathrm{Do.}\ 760}$	10·760
Atmospheric air	1·000294	1·000294
Carbonic acid	1·000473	1·000449
Hydrogen	1·000132	1·000138
Carbonic oxide	1·000345	1·000340
Nitrous oxide	1·000497	1·000503
Olefiant gas..	1·000656	1·000678
Marsh gas	1·000472	1·000443

In the above table $\sqrt{\mathrm{Do.}\ 760}$ denotes the square root of the dielectric constant (that of a vacuum being taken as unity), and 10·760 the coefficient of refraction, both at 0° C., and at the atmospheric pressure of 760 m.m. The equivalence of these two quantities agrees with the theory of Maxwell. Gases do not conduct electricity in a sensible amount.

Trajectory of the Electric Spark.—A. Tœpler.—The traces left upon surfaces of glass covered with a very thin layer of lamp-black by electric sparks passing from one pointed conductor to another, show under the microscope a regular structure. Sparks from 4 to 6 centimetres long generally trace a clear furrow 3 m.m. in breadth with a dark axis, the particles of soot being either projected laterally or accumulated along the axis. On the side of the positive conductor the trace of the spark is almost always ramified in bundles, which is not the case on the side of the negative conductor.

Remedy for Hydrophobia.—J. Jitzki, of Wilna, finds that the venom of *Coluber berus* and *Vipera berus* (both names for the common viper) is a cure for, and even a prophylactic against, the poison of *rabies*.

Theoretical Applications of the Experiment of Huyghens.—D. S. Stroumbo.—This interesting optical paper would not be intelligible without the accompanying diagrams.

Journal de Physique, January, 1874.

New Method for Discussion of the Problem of Diffraction in the Case of a Cylindrical Wave.—M. Cornu.

Optical Method of M. Lissajous Applied to the Study of Sounding Tubes.—M. Bourbouze.—The author employs a small thin drum with caoutchouc membranes, its interior placed in communication with a receiver like those used by M. Marey. The indications with this apparatus are opposite to those given by a simple membrane: the excursions of the drum membranes are greatest at a node, least in a ventral segment. A little mirror is glued to one of the membranes, and is caused to reflect a ray of light, as in M. Lissajous's experiments. To obtain the acoustical figures from two rectangular vibratory movements, the author stretches membranes (with mirrors) across the ends of two organ-pipes, and a ray is made to undergo double reflection by the mirrors.

Experiments on Surfusion and Supersaturation.—M. Gernez.—This describes some good arrangements for realising the phenomena with phosphorus, nitrate of lime, and acetate of soda.

Principle of Volta.—M. Auguste Righi.—The author seeks to prove the real existence of an electromotive force of contact independently of all chemical action of the surrounding medium. He describes a new electrometer for the purpose.

Apparatus for Showing Conical Refraction.—M. Laurent.

Physico-Chemical Researches on Gases and Liquids Condensed by Porous Carbon.—M. Melsens.—A *resumé* of experiments described to the Belgian Academy.

February, 1874.

Electro-Capillary Experiments.—M. Lippmann.—See *Comptes Rendus.*

New Method for Discussion of the Problem of Diffraction in the Case of a Cylindrical Wave.—M. Cornu.—Conclusion.

Note on a Means of Amplifying Considerably the very Small Displacements of a Rigid Rod.—M. Deprez.—He connects the extremity with a piston moving in a space completely filled with liquid, and communicating with a capillary tube which opens to the air. One observes the variations in the liquid column. A displacement of the piston 1-1000 m.m. may in this way be represented by 10 m.m. The suggestion is applicable to improvement of the spherometer and like instruments.

Construction of a Scale of Electrical Resistance.—M. Crova.

Equivalent Lens of an Optic System.—M. Lisleferme.

Notice of Monography of Liquid Bubbles.—MM. Marangoni and Stefanelli.—With an atmosphere of the vapour of the sulphide of carbon the authors succeeded in obtaining two bubbles, 60 centimetres diameter, probably the largest that have ever been seen. A curious effect observed is, that a bubble does not vibrate by any sound, however violent, transmitted from without, whereas it readily vibrates when the motion comes from the interior air. The phenomena of rupture of bubbles, the deformations of connected bubbles, and various other points are treated.

March, 1874.

Some General Theorems Relative to Static Electricity.—M. Bertrand.—The theorems are already known, but new and simple demonstrations are given, connecting them by a common principle.

Use of Quincke's Interference Apparatus for Construction of an Acoustic Pyrometer.—M. Chautard.

Centre of the Corona of Aurora Borealis.—M. Lespiault.

Note on a Means of Transmitting, Simultaneously, Signals in Two Directions by Means of a Telegraphic Apparatus of Compressed Air.—M. Deprez.

Some Experiments which may be made with a Tuning-Fork.—M. Gripon.—The author discusses the movement of a cord, that of a rod, the vibration of wires in liquids, and the movement of a liquid in a vibrating tube.

Favre and Valson on Crystalline Dissociation.—Given in full elsewhere.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sesquichloride of carbon and other chemical products. Albert Eugène Damoiseau, Paris. December 13, 1873.—No. 4103. It consists in manufacturing sesquichloride of carbon by causing a mixture, in the required proportions, of chlorine and hydrocarbon gases to pass through granulated bone-black (previously freed from calcareous matters), charcoal, pumice-stone, or other suitable porous material, contained in a platinum, porcelain, or other suitable tube heated to any suitable degree, and collecting the formed sesquichloride in any suitable receiver; my improved process consequently does entirely away with the use of solar light, and I intend applying the same to the manufacture of other chemical products besides sesquichloride of carbon in which the substitution of one or more equivalents of the hydrogen of a hydrocarbon is to take place either by chlorine, iodine, bromine, fluorine, or other similar agents.

Improvements in the extraction of sulphur from sulphur ores, and in the purification of sulphur. William Henry O'Shea, Beaufort Gardens, Middlesex. December 17, 1873.—No. 4153. According to this Provisional Specification, the sulphur ore or crude sulphur is placed in retorts heated externally by steam. To produce flowers of sulphur, melted sulphur is run in a continuous stream into a heated tube or vessel, and is evaporated as rapidly as it enters

Improvements in the manufacture of hydrochloric acid. Alexander Robertson Arrott, chemist, Saint Helen's, Lancaster. December 18, 1873.—No. 4164. The object of this invention is the obtaining hydrochloric acid from chloride of calcium.

Improvements in the evaporation of water, such improvements being applicable to the treatment of sewage and of saline solutions. Paul Curie, Gresham House, London. December 19, 1873.—No. 4181. This invention consists in producing a mixture of air and hot gases suitable for the process of evaporation, such gases being obtained by the combustion of fuel, either under steam-boilers or in other furnaces. The gases so obtained are then driven or aspirated into a reservoir, in which they are mixed with a sufficient quantity of cold air to bring the whole down to any desired temperature. The mixture of air and hot gases is then blown through the liquid sewage or saline solution, and the evaporation of the water thereby rapidly effected.

Improvements applicable to the manufacture of aluminium. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. (A communication from Frederic Jacquemart, Paris). December 22, 1873.—No. 4204. The object of this invention is to facilitate the manufacture of aluminium by preparing an artificial cryolite for use in that manufacture.

An improved process for the manufacture of artificial butter, lard, or shortening, for culinary and other purposes. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from L. D. Roudebush, New York). December 22, 1873.—No. 4209. The said invention relates to an improved process of manufacturing a substance to be used as a substitute for ordinary butter, and other like substances for culinary and other purposes.

Improvements in the manufacture of soap, and in apparatus employed therein. Michael Henry, patent agent, Fleet Chambers, Fleet Street, London. (A communication from Jean Hector Destibeaux, Boulevart Saint Martin, Paris). December 23, 1873.—No. 4211. Stearic acid or other concrete fatty acid is melted or dissolved in oleine or other oily or fatty body under a gentle heat, and hydrated or hydrous caustic soda is added to the mixture, such caustic soda containing an anhydrous proportion by weight of the fatty body. Double-bottomed frames or sesses are described having removable bottoms. Resins may be used.

Improvements in scouring wool and in utilising the products resulting therefrom. Dr. George Lunge, South Shields, Durham. (A communication from Dr Karl Kraut, Hanover, Germany). December 23, 1873.—No. 4212. The raw wool is washed in the ordinary apparatus by means of warm water to which carbonate of potassium has been added. The washing-waters are collected in tanks, and allowed to stand until the solid impurities subside. The supernatant liquor is then evaporated to dryness, and the residue heated in the bed of a furnace until it takes fire and burns off. The result is an ash which is often mixed with carbonaceous matter containing the carbonate of potassium employed for scouring, and the potassium present in the wool employed, the latter also mainly in the state of carbonate. The ash is then lixiviated, a solution of carbonate of potassium being yielded. One portion of such carbonate of potassium is used for scouring a fresh quantity of wool, and the portion not so employed is evaporated to dryness and calcined, yielding a fine kind of potash.

Improvements in the preparation of products of aniline and matters from which aniline is, or may be, derived suitable to be used in dyeing and printing and in the preparation of colouring matters. John Casthelaz, manufacturing chemist, Crumpall Vale Chemical Works, near Manchester. December 24, 1873.—No. 4225. According to this invention aniline or nitro-benzine is treated with sulphuric acid in excess and with bichromate of potash or other oxidising agent, with or without heat. From the product a soluble colouring matter can be extracted, which imparts a brown tint to woollen or other matters, the said brown tint changing to black when the dyed matters are treated with a bath of bichromate of potash, followed by an alkaline bath. Chromic acid, ammoniacal solution of copper, salt of copper, and several other agents may be substituted for the bichromate of potash.

TO CORRESPONDENTS.

⁂ Vol. XXIX. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxx. commenced on July 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

THE CHEMICAL NEWS.

Vol. XXX. No. 772.

HINTS TO STUDENTS.

In this number we give an account of the various colleges, institutions, and private establishments where the science of chemistry is taught, and where those who wish to devote themselves to its study may find the requisite facilities and the needful guidance. It will be evident at a glance that these facilities are now far more abundant and more accessible than was the case a quarter of a century ago. But the serious question naturally arises, whether the opportunities for study and research now existing are put to the best use, and whether they are bearing the fruit that might be hoped? True, the number of chemical students, counted up statistically, has very greatly increased. But there are students, and students. There are some who bring to their tasks devotion to science, patience, perseverance, and a disposition to be accurate in everything. There are others who may, indeed, attend the lecture-rooms and the laboratories of celebrated professors, but who do not believe in work and never earnestly seek to qualify themselves for it. The first-mentioned class we honour; as for the latter, we deplore their very existence. If work is not to be done accurately, it had better not be done at all. If a young man is not to become a sound chemist, he had better leave the study to others. Careless work hinders the progress of science, and must be cleared away, often at great expense of time and labour, before anything satisfactory can be done. Unsound, incompetent chemists injure the confidence of the public in the resources of science and in the benefits to be drawn from its revelations, and lower, not their own professional status only, but that of their worthier contemporaries. Let us bear in mind, that to have learnt a few chemical crotchets, to have absorbed a few paradoxes, and to have committed to memory a legion of formulæ, do not make a man a chemist. Before we accord that title to any one, we must be satisfied as to his power to do actual work. He may have passed examinations innumerable; he may be rich in the inventory of other men's treasures. We would put in his hands a loaf, and ask him to say how much alum is present in it. We would give him a sample of apatite or of cobalt ore, and bid him determine the phosphoric acid in the one, or the pure cobalt in the other. Or we would take him to the blue-vat, the lead chambers, the black-ash furnace, and, pointing out to him some of the unsettled questions which there frequently come before the observer, we would ask him to undertake its investigation. If we found him able to deal accurately with such subjects, we would bid him good speed, even though his knowledge of nomenclature and formulæ were of the slenderest, and though he might not be able to draw a single "spread eagle" or "crochet pattern" on the black-board.

Indeed, slightly modifying a familiar saying, we might declare that names and formulæ are the slaves of wise men, but the masters of fools. They are, at the best, subordinate means to an end, and to mistake them for the end itself is to radically misconceive the very nature of science. A name which the eye cannot take in a single glance, which you cannot copy without looking back two or three times to the original document, is to be condemned on the mere ground of its length, no matter what other recommendations it may possess. The nomenclature so much in fashion at the present day is about as well adapted to assist reasoning on chemical questions as would be the Roman numerals to serve in arithmetical operations.

Let it not be thought that we undervalue theory, or that we would advise the student to limit himself to the mere establishment of facts. We hold that facts only receive their full value when duly coordinated by sound theories. But between such theories and hypotheses, neither verified nor capable of verification, there is a heaven-wide difference. The more rapidly science is advancing, the more necessary it becomes to guard it from taking a wrong direction.

It is a fortunate circumstance that, in chemistry, the abstract and the practical lie very near together. We can scarcely solve any of the difficulties daily encountered in the chemical arts without aiding the progress of pure science. And how often researches undertaken from the love of abstract knowledge have led the enquirer to discoveries of practical value, has become almost a truism.

For all this, we cannot advise anyone to give his attention to chemistry except he feels in it an attraction independent of outward remuneration. As compared with men in other professions, the chemist, however eminent, reaps but slender rewards. At the same time, he is denied the privilege of being mistaken, which is conceded to all the rest of mankind. If, therefore, the ordinary prizes of life are the sole motive of the student, we should advise him to leave the laboratory and embark in engineering or in law. But if he feels a sincere attraction for the most fruitful and the most varied of all the sciences, let him then persevere. The time will surely come when the services of chemistry to civilisation and to industry will be better appreciated than at present, and when the claims of chemists will meet with full recognition.

SCHOOLS OF CHEMISTRY, &c.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 11th, 1875. It is conducted by means of Printed Papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects, according to the details specified under the several heads:—

1. Latin.
2. Any two of the following Languages:—Greek French, and German.

3. The English Language, English History, and Modern Geography.
4. Mathematics.
5. Natural Philosophy.
6. Chemistry.

The following are the particulars of the foregoing subjects of Examination:—

Languages.[*]

Latin—

One Latin subject, to be selected by the Senate one year and a half previously from the works of the undermentioned authors:—[†]

Virgil	One Book of the Georgics, and one Book of the Æneid.
Horace	Two Books of the Odes.
Sallust	The Conspiracy of Catiline, or the War with Jugurtha.
Cæsar	Two Books of the Gallic War.
Livy	One Book.
Cicero	De Senectute or De Amicitiâ, with One of the following Orations—Pro Lege Maniliâ, either of the four Catilinarian Orations, Pro Archiâ, Pro M. Marcello.
Ovid	One Book of the Metamorphoses, and one Book of the Epistles or Heroides.

The Paper in Latin will contain passages to be translated into English, with questions in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected. A separate Paper shall be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

Greek[‡]—

One Greek subject, to be selected by the Senate one year and a half previously from the works of the undermentioned authors:[‖]—

Homer	One Book.
Xenophon	One Book.

The Paper in Greek will contain passages to be translated into English, with questions in Grammar, and with questions in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected.

French—

The Paper in French will contain passages for translation into English, and questions in Grammar, limited to the Accidence.

German—

The Paper in German will contain passages for translation into English, and questions in Grammar, limited (except when German is taken as an alternative for Greek) to the Accidence.

The English Language, English History, and Modern Geography—

Orthography. Writing from Dictation. The Grammatical Structure of the Language.

History of England to the end of the Seventeenth Century, with questions in Modern Geography.

Mathematics.

Arithmetic—

The Ordinary Rules of Arithmetic.
Vulgar and Decimal Fractions.
Extraction of the Square Root.

Algebra—

Addition, Subtraction, Multiplication, and Division of Algebraical Quantities.
Proportion.
Arithmetical and Geometrical Progression.
Simple Equations.

Geometry—

The First Four Books of Euclid, or the subjects thereof.

Natural Philosophy.[*]

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*)—Ratio of the Power to the Weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Mirrors and Simple Lenses.

Heat—

Its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of heat. Specific and Latent heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry.

Chemistry of the Non-Metallic Elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water. Chemical peculiarities of Natural waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

On Monday morning at 9 o'clock in the week next but one ensuing, the Examiners will publish a List of the Candidates who have passed, arranged in alphabetical order. And on the Monday morning next following, at 9 o'clock, the Examiners will publish a List of the Candidates who have passed, arranged in Three Divisions—in the Honours Division in the order of proficiency; in the First and Second Divisions in alphabetical order.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners shall have been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination shall possess sufficient merit, the first among such Candidates will receive an Exhibition of Thirty Pounds per annum for the next Two Years; the second among such Candidates will receive an Exhibition of Twenty Pounds per annum for the next Two Years; and the third will receive an Exhibition of Fifteen Pounds per annum for the next Two Years; such Exhibitions to be payable in quarterly instalments, provided that on receiving each instalment the Exhibitioner declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within Three Academical Years[*] from the time of his passing the Matriculation Examination.

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[*] At the Examination of January, 1875, Greek will be ranked as optional with French and German, so that it will be sufficient for any Candidate to pass in any one of these three Languages; though credit will be given to Candidates in Greek in addition to French or German.

[†] The Latin Subjects for 1875 and 1876 are—For January, 1875:—*Horace*, Odes, Books iii. and iv. For June, 1875:—*Sallust*, The Conspiracy of Catiline. For January, 1876:—*Cicero*, De Amicitia and Pro Lege Manilia. For June, 1876:—*Horace*, Odes, Books i. and ii.

[‡] Candidates may substitute German for Greek.

[‖] The Greek Subjects for 1875 and 1876 are—For January, 1875:—*Xenophon*, Hellenics, Book vii. For June, 1875:—*Homer*, Odyssey, Book, xvii. For January, 1876:—*Xenophon*, Anabasis, Book vi. For June, 1876:—*Xenophon*, Anabasis, Book ii.

[*] The Questions in Natural Philosophy will be of a strictly elementary character.

Under the same circumstances, the fourth among such Candidates will receive a Prize to the value of Ten Pounds in Books, Philosophical Instruments, or Money; and the fifth and sixth will each receive a Prize to the value of Five Pounds in Books, Philosophical Instruments, or Money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has have attained the age of Eighteen years.

FIRST B.Sc. EXAMINATION.

The First B.Sc. Examination commences on the third Monday in July.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this Examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The Examination includes the following subjects[†]:—

MATHEMATICS.

Arithmetic—

The ordinary Rules of Arithmetic.

Vulgar and Decimal Fractions.

Extraction of the Square Root.

Algebra—

Addition, Subtraction, Multiplication, and Division of Algebraical Quantities.

Algebraical Proportion and Variation.

Permutations and Combinations.

Arithmetical and Geometrical Progression.

Simple and Compound Interest; Discount and Annuities for terms of years.

Simple and Quadratic Equations.

The nature and use of Logarithms.

Geometry—

The relations of Similar Figures.

The Eleventh Book of Euclid to Prop. 21, or the subjects thereof; together with the elementary properties of the Sphere, treated geometrically.

The Mensuration of the simpler Plane and solid Figures, including the Cylinder and Cone.

The equation to the Straight Line and the equation to the Circle referred to rectangular co-ordinates.

The equations to the Conic Sections referred to rectangular co-ordinates.

Plane Trigonometry—

Plane Trigonometry as far as to enable the Candidate to solve all the cases of Plane Triangles.

The expression for the Area of a Triangle in terms of its sides.

MECHANICAL PHILOSOPHY.

(*The subjects marked with an asterisk are to be treated independently of mathematical symbols, or only by simple geometrical methods.*)

**Statics*—

Elementary Statics, including the Resolution of Forces, the Mechanical Powers, and the Centre of Gravity.

**Dynamics*—

Elementary Dynamics, including the Laws of Motion, and propositions required for determining the Rectilinear Motion of a Body whether free or along inclined planes.

**Hydrostatics, Hydraulics, and Pneumatics*—

Elementary propositions respecting the nature, transmission, and intensity of Fluid Pressure, and the Conditions of Equilibrium of Floating Bodies.

Specific Gravity, and modes of determining it.

The Common Pump and Forcing-Pump.

The Hydrostatic Press.

The Barometer.

The Air-Pump.

The Steam-Engine.

**Optics*—

Laws of Reflexion and Refraction; Reflexion at plane mirrors; Reflexion at spherical mirrors, and Refraction through lenses, the incident pencils being direct. Description of the Eye; Simple Instruments; Camera Obscura and Simple Telescope.

NATURAL PHILOSOPHY.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vapourisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-Magnetic and Magneto-Electric machines.

Terrestrial Magnetism.

INORGANIC CHEMISTRY.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light, Photography.

Oxygen. Ozone.

Hydrogen. Water.

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[*] By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of a higher grade in the following year; which period may be either more or less than a Calendar year. Thus the interval between the *First* Examinations in Arts, Science, and Medicine, and the *Second* Examinations of the next year in these Faculties respectively, is about sixteen months, whilst the interval between the Second B.A. Examination and the M.A. Examination of the next year, or between the Second B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

[†] Candidates who pass in all the subjects of the First B.Sc. Examination, and also *at the same time* in the Practical Chemistry of the Preliminary Scientific (M.B.) Examination, will be considered as having passed both the First B.Sc. Examination and the Preliminary Scientific (M.B.) Examination, without being required to pay an additional Fee.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a Class. Metallurgical Processes. Alloys. Classification of the Metals

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars, Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

PRELIMINARY SCIENTIFIC (M.B.) EXAMINATION.[*]

The Preliminary Scientific Examination commences on the third Monday in July in each year.

No Candidate is admitted to this Examination until he has completed his seventeenth year, and has either passed the Matriculation Examination or taken a Degree in Arts in one of the Universities of Sydney, Melbourne, Calcutta, or Madras.

The Fee for this Examination is £5.

Candidates are examined in the following subjects of the First B.Sc. Examination[†]:—

Mechanical and Natural Philosophy.
Inorganic Chemistry.
Botany and Vegetable Physiology.
Zoology.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in all the foregoing subjects of examination, and also in Practical Chemistry.

EXAMINATION FOR HONOURS.

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics and Mechanical Philosophy, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Mathematics and Mechanical Philosophy at the First B.A. Examination, in which case he will not be admissible to the Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the First B.Sc. Examination in which case he will not be admissible to the Examination for Honours in that subject. And any Candidate who has passed the Preliminary Scientific (M.B.) Examination in all its subjects may be examined at the Honours Examination next following the Preliminary Scientific (M.B.) Examination at which he has passed, in (1) Experimental Physics, (2) Chemistry, (3) Botany, and (4) Zoology; unless he has previously obtained an Exhibition in either of these subjects at the First B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Experimental Physics are examined in any of the following subjects, at the option of the Examiners:—

Statics.
Dynamics.
Hydrostatics, Hydraulics, and Pneumatics.
Optics.
Heat.
Electricity.
Magnetism.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their Combinations.
Electro-Chemistry.
Radiant Chemical Action.

In the Examination for Honours, the Candidate, not being more than twenty-two years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics will receive an Exhibition of £40 per annum for the next two years.

SECOND B.SC. EXAMINATION.

The Second B.Sc. Examination commences on the fourth Monday in October.

Candidates for this Examination who have not previously taken the Degree of B.A. are required either to have passed the First B.Sc. Examination at least one academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

The Examination includes the following subjects:—

MECHANICAL AND NATURAL PHILOSOPHY.

(The following subjects are to be treated Experimentally, and also Mathematically so far as the subjects of the First B.Sc. Examination are applicable to them.)

Statics—

Elementary Statics, including the Resolution of Forces, the Mechanical Powers, the Centre of Gravity, and simple cases of Equilibrium of bodies or systems of bodies under the action of Gravity.

Dynamics—

Elementary Dynamics, including the Laws of Motion, and Propositions required for determining the Rectilinear Motion of a body, whether free or along inclined planes.

Direct Impact of Spheres.

Motion of Projectiles, and the simpler cases of motion round Centres of Force.

Elementary Propositions relating to Mechanical Work.

Hydrostatics, Hydraulics, and Pneumatics—

Elementary Propositions respecting the nature, transmission, and intensity of Fluid Pressure, and the Conditions of Equilibrium of Floating Bodies.

Nature and simple properties of Elastic Fluids, and the Pressures produced by them.

Specific Gravity, and modes of determining it.

The Common Pump and Forcing-Pump.

The Hydrostatic Press.

The Barometer.

The Air-Pump.

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[*] Candidates who matriculated previously to January, 1861, will not be required to pass the Preliminary Scientific (M.B.) Examination in any other subjects than Chemistry and Botany; and they will be allowed to pass the Preliminary Scientific Examination and the First M.B. Examination in the same year, if they so prefer.

[†] Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and also *at the same time* in the Mathematics of the First B.Sc. Examination, will be considered as having passed both the Preliminary Scientific Examination, and also the First B.Sc. Examination, without being required to pay an additional Fee; and Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and who have *previously* passed the First B.A. Examination, will be admissible to the Second B.Sc. Examination.

The Steam-Engine.

Optics (Geometrical)—

Laws of Reflection and Refraction; Reflection at plane mirrors; Reflection at spherical mirrors, and Refraction through lenses, the incident pencils being direct.

Separation of Solar Light into rays of different colours; description of the Solar Spectrum; description of the Eye; Simple Optical Instruments; Camera Obscura; Reflecting and Refracting Telescopes.

Acoustics—

Nature of Sounds; mode of Propagation; Musical Tones, and simple propositions respecting them.

Optics (Physical)—

Fundamental Hypotheses of the Undulatory Theory respecting the Origin and Propagation of Light.

General explanation of Interferences; formation of Newton's Rings, with descriptions of simple experiments which elucidate the effects of Interference.

Polarised Light, with the description of simple experimental modes of producing it.

Astronomy—

Systems of Great Circles to which the positions of the Heavenly Bodies are referred.

Principal phenomena depending on the Motion of the Earth round the Sun, and its Rotatory Motion round its own Axis.

General description of the Solar System.

General explanation of Solar and Lunar Eclipses.

Organic Chemistry.

Ultimate Analysis of Organic Bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of Organic Acids and Bases; examination of Products of Decomposition; determination of the Vapour Density of Volatile Bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen Group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerin. Fatty and Oily Bodies. Saponification.

Vegetable Acids—the principal.

Ammonia and its derivatives. Ammonium and Ammoniacal Salts. Amides and Amines: their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumen, Casein, Gluten, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

Animal Physiology.

The Mechanical, Chemical, and Vital properties of the several elementary Tissues of Animals.

Nature and Composition of the principal substances used as Food by Animals.

Comparative Structure and Actions of the Organs of Digestion, Absorption, and Assimilation.

Composition and properties of the Chyle, Lymph, and Blood.

Comparative Structure, Arrangement, and Actions of the Circulatory and Respiratory Organs in the Animal series.

Chemical effects of Respiration.

Essential Structure of Secretory Organs; principal varieties presented in the structure of the Liver and the Kidney.

Objects of the several Excretory processes.

Development of Heat, Light, and Electricity by Animals.

Comparative Structure and Actions of the Nervous System.

Comparative Structure and Actions of the Organs of Sense.

Animal Mechanics.

General History of Development and Metamorphosis in the principal types of Animals.

Candidates will not be approved by the Examiners unless they have shown a competent knowledge in—

1. Mechanical and Natural Philosophy.
2. Chemistry.
3. Animal Physiology.
4. Geology and Palæontology.
5. Logic and Moral Philosophy.

A Certificate, under the Seal of the University and signed by the Chancellor, will be delivered at the Public Presentation for Degrees to each Candidate who has passed.

Examination for Honours.

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the Second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics and Natural Philosophy, (2) Logic and Moral Philosophy, (3) Chemistry, (4) Zoology, and (5) Geology and Palæontology. And any Bachelor of Arts who has passed the Second B.Sc. Examination in Chemistry and in Geology and Palæontology may be examined for Honours in one or more of the above-mentioned subjects, provided he has gone through the Pass Examination in the corresponding subject or subjects immediately before; unless he had previously obtained a Scholarship at the Second B.A. Examination in either of the subjects which are common to it with the Second B.Sc. Examination, in which case he is not admissible to the Examination for honours in that subject.

Candidates for Honours in Mathematics and Natural Philosophy will be examined in the Honours-subjects of the First B.Sc. Examination, carried to a higher development, and also in the following:—

Higher Co-ordinate Geometry of Two, and of Three, Dimensions.

Differential Equations.

Calculus of Variations.

Dynamics of Rigid Bodies.

Hydrostatics and Hydrodynamics.

Optics.

Plane Astronomy.

The Candidate, being not more than twenty-three years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

Doctor of Science.

The examination for the Degree of Doctor of Science takes place annually within the first twenty-one days of June, and the Examination in each branch occupies four days.

No Candidate is admitted to this Examination until after the expiration of Two Academical Years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year must give notice of their intention to the Registrar, and pay to him a Fee of Ten Pounds on or before the 1st of Apri If a Candidate fail to pass the Examination, the Fee not returned to him; but he is admissible to any *one* subsequent D.Sc. Examination without the payment of any additional Fee, provided that he give notice to the Registrar on or before the 1st of May.

For the Degree of D.Sc., Chemical Candidates can be examined either in Inorganic or Organic Chemistry, but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge of the Principal Subject, and a general acquaintance with the Subsidiary Subject or Subjects.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or Chemical Technology in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

The Session begins on Thursday, the 1st of October, and ends about the end of June.

Chemistry.—Professor Williamson, Ph.D., F.R.S.
Assistant Professor.—Charles Graham, D.Sc.

GENERAL COURSE.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £7 7s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry.

This commences in the second week in February, and occupies Five Lectures weekly till about the end of March. It includes a study of the characteristics and metamophoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Practical Chemistry.

Professor Williamson, Ph.D., F.R.S.

I. *Elementary Course.*

About Forty Lessons, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

II. *Senior Course.*

This Course consists of Twenty Lessons, commencing in the first week in May.

The First Half of the Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerin, alkaloids, &c.

The Second Half of the Course includes tests for mineral poisons in organic mixtures: also tests for organic bodies, such as the alkaloids, when mixed with other organic substances.

Volumetric methods of the quantitative analysis of sugar and urea, chlorides, phosphates, hardness of water, alkalimetry, are practised.

Analyses of milk and of ashes of blood.

Fee, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

III. *Summer Matriculation Course.*

Professor Williamson, Ph.D., F.R.S., and Charles Graham, D.Sc.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other Lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the Practical Lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Tuesday, April 13, 1875.

Fee, including cost of materials and apparatus, £4 4s.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,

AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are now given at the New Buildings, South Kensington:—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Mineral Chemistry, commencing October 5, 1874. A Course of Thirty Lectures on Organic Chemistry, commencing January 29, 1875. Laboratory instruction, consisting of an elementary and an advanced course, commencing on October 1. Fees—Lectures on Mineral Chemistry, £4; Lectures on Organic Chemistry, £3; together £6. Laboratory instruction—£12 for three months, £9 for two months, and £5 for one month.

Biology, by Professor Huxley, LL.D., F.R.S., A Course of Eighty Lectures on Biology (or Natural History, including Palæontology), with Laboratory instruction, commencing October 5, 1874. Fee for the full Course, £10—for the Lectures only, £4; for the Laboratory instruction, £6.

Physics, by Professor Frederick Guthrie. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures. The Course will commence on October 5, 1874. Fee for Lectures and Laboratory work, £10.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accomodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

The instruction in Chemical Science embraces—

(1). A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

(2). A systematic Laboratory Course for the Practice of Chemical Analysis.

(3). An advanced Laboratory Course for technical applications of Chemical Analysis and for Chemical Research.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Thursday, October 1, 1874. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month. This charge does not include the fees for attending the Lectures.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory Practice, especially in Assaying.

The object of the Lectures is the communication of such instruction as the Student may be able to apply to the greatest practical advantage when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Chemistry, Geology, Mineralogy, and Applied Mechanics.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant being to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

KING'S COLLEGE.

Professor of Chemistry and Practical Chemistry.—C. L. Bloxam, F.C.S.

Demonstrators.—W. N. Hartley, F.C.S., and J. M. Thomson, F.C.S.

The Session commences on the 1st of October.

I. For Students intending to devote themselves to Medicine, Pharmacy, or Scientific Chemistry, or to take a degree in Medicine or Science in the University of London. A Course of between sixty and seventy Lectures, by the Professor, commencing in October and terminating in March. Inorganic Chemistry, October till January. Organic Chemistry, February and March. On Monday, Wednesday, and Thursday, from 10.15 till 11.15. Fee, £8 8s. for the Course, or £11 11s. perpetual attendance.

II. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms, though it is strongly recommended that the Course be taken up in the Michaelmas Term. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term, or £8 8s. for the year.

III. For Students who have any examination in prospect, or who require general guidance in the Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evening, from 6.30 till 7.30. Fee, £1 1s. for the Course.

PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 to 12.15 a.m. Fee, £5 5s. for the Course.

Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

LABORATORY OF ANALYTICAL AND EXPERIMENTAL CHEMISTRY.

For the study of all branches of Practical Chemistry. Open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry—One month, £4 4s.; three months, £10 10s.; six months, £18 18s.; nine months, £26 5s.

THE SCHOOL OF PHARMACY,

17, Bloomsbury Square, W.C.

(in connection with the pharmaceutical society.)

The Session commences on October 1st, and extends to the end of July.

Lectures on Chemistry and Pharmacy, by Dr. Redwood.

Lectures on Botany and Materia Medica, by Professor Bentley.

Practical Chemistry.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on October 1st, under the direction of Professor Attfield, Ph.D.

Students can enter at any period during the Session.

Two Scholarships (the Jacob Bell Memorial Scholarship), of £30 a year each, are open to competition annually in July.

Students have free admission to the Library and Museum.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects:—Junior Class, Chemistry—First year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Lecturer on Chemistry.—Mr. G. Chaloner, F.C.S. Tuesdays, 8 to 9, commencing October 6.

Manipulation and Analysis.—Saturdays, 7 to 10 p.m. Under Mr. Chaloner's direction.

ROYAL POLYTECHNIC INSTITUTION,

309, Regent Street, W.

The Chemical and Experimental Laboratories are under the direction of Professor Edward V. Gardner, F.A.S., M.S.A., assisted by an efficient staff of Masters and Assistants.

The classes on Heat, Chemistry, Galvanism, Magnetism, and Electricity will commence in October; they are adapted to the wants of gentlemen preparing for Matriculation, Woolwich, Sandhurst, or Direct Commissions.

The Laboratory is excellently fitted, and gentlemen can pursue their studies privately under the supervision of Professor Gardner. The Laboratory is open from 10 to 5 daily, and each evening from 7 to 10.

The Fees are arranged according to the time occupied.

Private Rooms.—A new feature in the arrangements for scientific study at the Polytechnic is the setting apart of rooms especially fitted for the pursuit of experiments and investigations of a private nature. These can be secured, with or without professional assistance, by those who need such advantages.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES,

44, Berners Street, W.

Conducted by Professor E. V. Gardner, F.A.S., M.S.A., assisted by efficient Masters.

The Laboratory is open morning and evening throughout the year, and is fitted for the convenience of private students, whose studies are under the immediate charge of Professor Gardner and his Assistants.

The subjects of Geology, Botany, and Mineralogy are in the hands of competent teachers, whose arrangements depend upon the number of members joining the class or classes.

Courses of Lectures on Electricity, Galvanism, Magnetism, &c., embracing the department of "Experimental Science" required by the Government Council of Education, are regularly established, and can be joined at any time.

The classes on the Science and Practice of Steam, and of Photography, are formed three times a year. Times of meeting, by mutual arrangement of the students and the Professor.

A Course of Lectures on Heat and Chemistry, commencing in October. Fee, £4 4s. The same course can be pursued in private study, commencing at other periods if preferred. It embraces all that is required by the Government and London University Matriculation Examinations.

Tutorial Department.—Provision has now been made by which gentlemen can be conducted through the different branches of study—Classics, Mathematics, English, Greek, Latin, French, German, Drawing (Mechanical, Free-Hand, and Object), Mechanics, Chemistry, and the Natural and Experimental Sciences—in the class-rooms at Berners College.

NORTH LONDON SCHOOL OF CHEMISTRY AND PHARMACY,

54, Kentish Town Road, N.W.

Conducted by Mr. J. C. Braithwaite.

The Session 1874-75 commences on the 1st of October when the Laboratory will be open for Instruction in Practical Chemistry.

The classes for Chemistry, Materia Medica, Botany, and Latin meet at 8 p.m. Fee to either class, 10s. 6d. per month.

The Botanical Garden affords facilities to students desirous of acquiring a practical knowledge of Botany. During the season, Botanical Excursions are made every Saturday at 10 a.m.

As each pupil works independently, he can enter at any period to either Classes or Laboratory.

SOUTH LONDON SCHOOL OF CHEMISTRY,

325, Kennington Road.

The subjects taught include Chemistry, Botany, Physics, Latin, Materia Medica, and Pharmacy. All apparatus and chemicals are provided for the students. There is also a special department for Instruction in Food Analysis at the Central Public Laboratory, Kennington Cross, under the personal supervision of the Director, who has been appointed Public Analyst. The Chemical portion of the Course consists of Ten Months' Lectures' on Inorganic and Organic Chemistry. The Lecturer is Dr. John Muter, F.C.S., and the hour is 10 a.m. daily. The Laboratory is open daily for Practical Instruction from 10 till 4. Secretary, Mr. W. Baxter.

The Session commences on September 15th.

ST. MARGARET'S TECHNICAL DAY SCHOOL FOR BOYS,

Near Artillery Row, Victoria Street, Westminster.

Head Master.—Mr. Robert E. H. Goffin.

The object of the School is to supply a sound, practical Education, with especial regard to technical training, for boys from the age of seven years and upwards.

The School will be open to all boys on payment, in advance, of an entrance fee of 2s. 6d., and a tuition fee of 10s. per quarter.

Numerous Exhibitions are reserved for boys who have been for three years at least at any Public Elementary School or Schools in the Parishes of St. Margaret and St. John, Westminster, or the Parish of St. Luke, Chelsea, and have passed the Government Inspector's Examination in the standard suitable to their age and standing.

The Course of Education includes Mathematics; Theoretical and Applied Mechanics; Acoustics, Light, and Heat; Inorganic Chemistry; Electricity and Magnetism; Practical Solid Geometry; Physical Geography; Animal Physiology; Steam and Steam Engines.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MED COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Mo nesday, and Friday, at 10 a.m. One course, £

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. day, Tuesday, and Friday, from 11 to 1. One c £2 2s.

CHARING CROSS HOSPITAL AND COLLE

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. *Demonstrator.*—T. Holas, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday and Friday. One session, £2 2s.

Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, and Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

Physiological Chemistry.—Demonstrator—Mr. S. W. Moore.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

LONDON HOSPITAL.

Lectures on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m. One session, £7 7s.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Thursday, and Saturday, at 9 a.m. One session, £3 3s.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 9 a.m. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S.

Inorganic Course.—Arranged for the requirements of the London University Preliminary Scientific Examination. Tuesday, Friday, and Saturday, at 9 a.m. Fee, £3 3s.

Organic Course.—Arranged to meet the requirements of the London University First M.B. Examination. Tuesday and Friday at 10 a.m. £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. Heisch. Monday, Thursday, and Friday, at 3; Saturday, at 11. One session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Heisch. Monday and Thursday at 3; Friday, at 11.30. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One Course. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £3 3s.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Dr. Odling, F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

Demonstrator.—J. W. Hicks, M.A.

LECTURES IN MICHAELMAS TERM.

Chemistry, general principles, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Spectroscopic Analysis, by the Professor.

Practical Chemistry, by the Demonstrator, daily.

Organic Chemistry, by Mr. Main, at St. John's College

Volumetric Analysis, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN LENT TERM.

Chemistry, general principles continued, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Quantitative Analysis, by the Professor, same days, at 1.

Practical Chemistry, by the Demonstrator, daily.

Elementary Chemistry, by Mr. Main, at St. John's College.

Quantitative Analysis of rarer elements, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN EASTER TERM.

History of Chemical Philosophy, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Quantitative Analysis, same days, at 3.

Elementary Inorganic Chemistry, by the Demonstrator.

Chemistry, continued, by Mr. Main, at St. John's College.

Organic Analysis, by Mr. Apjohn, Gonville and Caius College.

The Chemical Laboratory of the University is open daily, from 10 a.m. until 6 p.m., for the use of Students, under the direction of the Professor. The Demonstrator attends there daily to give instruction in manipulation, alternately in the morning and afternoon.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professors of Chemistry.—Alfred Hill, M.D., and A. G. Anderson. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. G. Anderson. Thursday and Friday, at 2 p.m.

BLACKBURN SCHOOL OF CHEMISTRY.

Professor of Chemistry.—Mr. George Whewell, F.C.S.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Wednesday, and Friday, at 8.30. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor.—A. H. Church, M.A. Oxon.

Assistant.—R. C. Woodcock, F.C.S.

The Autumn Session commenced on the 13th of August; it divides on the 6th of October, and terminates about the 18th of December.

The Chemical instruction comprises Three Courses of Lectures and Laboratory Practice:—

(1). 32 Lectures on Inorganic Chemistry.
(2). 32 Lectures on Organic Chemistry.
(3). 24 Lectures on Agricultural Chemistry.
(4). 32 Lessons on Chemical Manipulation.
(5). 32 Lessons on Qualitative Analysis.
(6). 32 (or more) Lessons on Quantitative Analysis.

Catechetical Lectures are also given, while analyses of manures, oil-cakes, minerals, soils, waters, &c., are daily performed in the College Laboratories, and Chemico-Agricultural researches undertaken by the more advanced Students, under the immediate direction of Professor Church.

The text-books used are Church's "Laboratory Guide," Roscoe's "Chemistry," and Church and Dyer's edition of "How Crops Grow."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Chemistry and Practical Chemistry.—J. Campbell Brown, D.Sc. Lond., F.C.S.

The first half of the Course, to Christmas, includes all the branches of Chemistry required for the Matriculation Examination of the University of London.

The Course consists of 100 Lectures, and is divided as follows:—

1. Chemical Physics.
2. Chemistry of the Metalloids.
3. Chemistry of the Metals and their Compounds.
4. Organic Chemistry.
5. Technological Chemistry.

Fee for the Course, £5 5s.

Technological and other non-medical Students may take out any of the divisions separately—Fee, £1 1s.; but no certificates will be given until the whole Course has been attended.

Practical Chemistry.—The new Laboratories, which accomodate eighty working Students, are now open, and those who desire to prosecute Practical Chemistry, analysis, or original research, will be provided with separate working-benches and cupboards, with tools, fuel, water, and gas. Fees, from £1 1s. to £4 4s. per month.

The following Classes have been arranged:—

1. Practical Exercises on the Non-Metallic Elements and their Gaseous Compounds. In November and December, at 4 p.m. Fee, £2 2s.

2. Qualitative Analysis of Inorganic Acids and Bases in Solutions containing one of each; Examination of Urine, Bile, Urinary Deposits and Calculi, &c. Monday, Tuesday, and Friday, at 10.30 a.m. Three months, commencing May 1. Fee, £3 3s.

3. Qualitative Analysis of Complex Mineral Substances. Monday and Friday, at 11.30 a.m., commencing May 1. Fee, £3 3s.

4. Practical Exercises in Technology, Pharmaceutical Chemistry, and Toxicology, at 4 p.m., commencing January 14. Fee, £5 5s.

5. Qualitative Analysis of Organic Substances, especially those in the List for 1st M.B. Exam. of Lond. Univ. In April, May, and June. Fee, £3 3s.

6. Quantitative Analysis. Students may enter at any time.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY,

7 and 9, Hackin's Hey, Liverpool.

Conducted by Mr. A. Norman Tate.

Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.).

Fees—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for Lectures and practical work.

A separate working-bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the Course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage.

LIVERPOOL OPERATIVES' SCIENCE CLASSES

(IN CONNECTION WITH THE GOVERNMENT DEPARTMENT OF SCIENCE AND ART, AND THE OPERATIVE TRADES' HALL, LIVERPOOL).

Session extends from September 16, 1874, to end of April, 1875.

Chairman.—Mr. James Samuelson.

Honorary Secretary.—Mr. Michael Fitzpatrick, 62, Seel Street.

Lecturer on Chemistry and Laboratory Practice.—Mr. Norman Tate.

Assistant Lecturers.—Mr. Percy Hollis and Mr. Hugh Hughes.

Lecturer on Physics.—Mr. Gordon.

Classes for the study of Inorganic Chemistry and Laboratory Practice will meet on Wednesday evenings in the School-Board Schools, Queen's Road, and on Friday evenings at Mr. Tate's Laboratory, 9, Hackin's Hey. Other Chemical Classes are being organised.

Classes for the study of Acoustics, Light and Heat, Electricity and Magnetism, &c., will meet under the care of Mr. Gordon in the National Schools, Everton Valley.

Arrangements have been made whereby teachers and pupil teachers of public elementary schools will be admitted to the Chemistry Classes at a nominal fee of one shilling. The fees to other pupils are (not including use of glass and fragile apparatus)—

For each Course of Lectures—Artisans, Half-a-Crown; Non-Artisans, One Guinea.

For each Course of Laboratory Practice—Artisans, One Guinea; Non-Artizans, Three Guineas.

All Pupils are expected to present themselves at the next May Examination of the Science and Art Department.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with Chemistry, such as light, heat, electricity, &c.

Particular attention is devoted to instruction in the practice of systematic analytical operations, whereby Students will be enabled to determine accurately the general and proximate constituents of substances, and so arrive at a knowledge of their nature and properties.

Instruction in the application of chemical data to medicine and agriculture, and to the chemical and metallurgical operations, comprising Technology, will be given, to qualify Students for these avocations.

The Students will invariably be controlled and directed in their study and work by the Principal and competent assistants. Ample Laboratory accommodation is provided for Students, and such general appliances as will facilitate their progress in acquiring a knowledge of the specialities taught in the College.

The Students' Laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily. Fees—10 guineas per quarter of three months, or 35 guineas per annum, payable in advance. Students provide all their own apparatus and books.

Medical and Pharmaceutical Students are admitted for one hour per day. Fee for three months, £2 2s.

A Course of Lectures will be delivered to the Students during the winter months. Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. Thomas Fairley, F.C.S.

Daily, except Wednesday and Saturday, at 11 a.m. First Session, £4 4s. Second Session, £3 3s.

SUMMER SESSION.

Practical Chemistry.—Mr. Fairley, F.C.S.

Mondays and Tuesdays, 9.30 to 11. Each Course, £3 3s.

General Chemical Students.—The Laboratories are open daily, under the direction of Mr. Fairley, for the instruction of General Students in Chemical Manipulation, Technical Chemistry, and all branches of analysis; and also for the use of gentlemen wishing to pursue special chemical researches.

The fees, payable in advance to the Treasurer, are as follows:—For one month, £4 4s.; for two months, £7 7s.; for three months, £10 10s.; for four months, £13 13s.; for five months, £15 15s.; for six months, £17 17s.; for nine months, £21. Special fees will be charged to Students who do not wish to work every day in the week.

The Chemical Museum contains minerals, metallic ores and metals, rare chemical substances, and illustrations of the most important chemical manufactures in their different stages.

Curator.—Mr. Scattergood.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry, commence on Friday, September 25, at 8 p.m.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

Professor of Chemistry.—Dr. T. E. Thorpe, F.R.S.E.

Professor of Physics and Mathematics.—A. W. Rücker, M.A.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Professor.—Francis Jones.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry. There is a lecture-room and second Laboratory, affording accommodation for seventy-two Students.

OWENS COLLEGE, MANCHESTER.

Professor and Director of the Chemical Laboratories.—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor C. Schorlemmer, F.R.S.

Demonstrator and Assistant Lecturer.—Mr. W. Dittmar, F.R.S.E.

Assistant Demonstrators.—Mr. W. Carleton Williams, F.C.S., and Mr. Harry Grimshaw, F.C.S.

Lecture Courses.

Systematic Chemistry.—Junior Class—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important compounds; (2) Organic Chemistry, giving the composition and relations of the best defined groups of organic bodies and the laws regulating their formation.

The instruction in Systematic Chemistry is given by means (*a*) of Experimental Lectures and (*b*) of Tutorial Classes. The Tutorial Classes will meet for recapitulation, and for the correction of the written exercises given out in the Lectures, at times to be fixed at the commencement of the Session.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—Professor C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

Technological Chemistry.—Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows:—

1. Ten Lectures on the Modes of Producing and Utilising Heat and Light, by Mr. Dittmar.
2. Ten Lectures on Water and Air and the Chemistry of the Alkali Manufacture, by Professor Roscoe.
3. Ten Lectures on the Chemistry of Colouring Matter, Dyeing and Calico Printing, by Professor Schorlemmer.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Chemical Philosophy.—Professor C. Schorlemmer, F.R.S. Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. Dittmar, F.R.S.E. Wednesday, from 9.30 to 10.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

All first year's Laboratory Students are required to attend this Class, and to perform the written exercises and to answer the *viva voce* questions given out.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 10.30 a.m. until 5.30 p.m., except on Saturdays, when they will be closed at 1.30 p.m.

The Laboratories are fitted with every convenience for the prosecution of Practical Chemistry, all branches of Qualitative and Quantitative Analysis, and original research. Each Student is provided with a separate working-table, a set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Regular Students, or those preparing for Degrees, may enter for two days a week at a fee of £9 9s. All other Students will be required to enter according to the following scale, and those working in the Quantitative Laboratory will be required to enter for not less than four days per week.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

EVENING CLASSES.

Chemistry.

First Lecture Course.—(The Non-Metallic Elements).—Professor Roscoe. Monday, from 8.35.

Second Lecture Course.—(The Metals).—Mr. Williams. Friday, from 8.5 to 9.5 p.m.

Third Lecture Course.—(Organic Chemistry).—Mr. Schorlemmer. Monday, from 8.5 to 9.5 p.m.

Technological Chemistry.—(Sulphuric Acid, Alkalies, &c.).—Mr. Dittmar. Thursday from 7 to 8.

Laboratory Courses.—Professor Roscoe and Mr. Williams. Monday, from 6 to 8.30 p.m.

QUEENWOOD COLLEGE,
NEAR STOCKBRIDGE, HANTS.

The Science Department of the above College is under the direction of Frank Clowes, B.Sc. Lond., F.C.S. Lectures are delivered during term time on Chemistry and Natural Philosophy, and a well-appointed Chemical Laboratory is used by all but the youngest pupils. The Course of Instruction is well suited to meet the requirements of the London University and College of Surgeons Examinations.

Principal.—C. Willmore.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.
(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Experimental Physics.—Professor A. S. Herschel, B.A., F.R.A.S. First Year Course—Mechanics, Sound, Heat, and Steam. Monday, Wednesday, and Friday, at 3 p.m. Second Year Course—Light, Magnetism, and Electricity. Tuesday and Thursday, at 3 p.m.

Experimental Lectures, and Questions for written Exercises, will be given at each meeting of the Class. Occasional visits to Mining and Manufacturing Establishments, to see the operation of Physical Processes described in the demonstrations of this Course, and the Course of the previous year, will be arranged, from time to time, during the Session. Fee, £5 5s.

Physical Laboratory.—The Physical Laboratory, for Physical Experiments, is open daily, from 10 a.m. to 5 p.m., excepting on Saturdays, when it closes at 1 p.m. Fees—Attendance per day weekly, £1 1s. per term.

Chemistry.—Professor—A. Freire-Marreco, M.A. *Demonstrator*—E. Haigh, Assoc. Phys. Science.

Junior Division.—General Principles of Chemistry; History of the Non-Metallic Elements. History of the Metals and their more important compounds; Principles of Qualitative Analysis. Monday, Wednesday, and Friday, at 11 a.m.

Senior Division.—Elements of Organic Chemistry, Tuesdays, at 11 a.m. Applied Chemistry, Thursdays, at 11 a.m. Fee, £5 5s.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees.*—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the 5th of October, 1874.

In addition to the class-fees, Students will be required to pay an entrance fee of £1 1s. Students who do not enter to more than two classes may commute this on payment of seven shillings entrance fee for each Course.

Students desirous of studying the whole of the four subjects professed in the College—viz., Mathematics, Experimental Physics, Chemistry, and Geology—may compound for the class fees, by payment of £17 17s.

Evening Classes.—Professor A. Freire-Marreco, M.A. Twelve Lectures on Inorganic Chemistry. Mondays, at 7.45, commencing November 2, 1874.

BOROUGH ANALYST'S LABORATORY,
1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSON'S UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

THE "YOUNG" CHAIR OF TECHNICAL CHEMISTRY,
ANDERSON'S UNIVERSITY, GLASGOW.

Professor.—Gustav Bischof.

This Chair has for its object the Instruction of Students in Chemistry as applied to the various branches of Industry in Chemical and other works, Metallurgy, Agriculture, &c.

In addition to the practical working in the Laboratory, Students have the advantage of attending Lectures on the various subjects of Technical Chemistry.

The outline of the Course of Lectures, which are illustrated by Experiments, Specimens, and Diagrams, and which will be completed in three consecutive Sessions, is as follows:—

First Session.—Crude Materials and Products of Chemical Industry, such as compounds of Potassium, Sodium, Sulphur, Chlorine, Ammonium, &c.; Glass, Ceramic Ware, Gypsum, Lime, and Mortar.

Second Session.—Vegetable Fibres and their Technical Application; Animal Substances and their Technical Application; Food; Dyeing and Printing; Materials and Apparatus employed for producing Artificial Light and Heat.

Third Session.—Chemical Metallurgy, Extraction of the Metals from their Ores, and Technical Application of Metals and Metallic Compounds.

The Session commences on the first Tuesday in November, and closes on the last day of July.

The Laboratory is open daily, from 10 to 4, and on Saturdays from 10 to 1 o'clock, for practical working by the Students, under the superintendence of the Professor and his Assistants.

The Fees for attending the Laboratory and Lectures are £18 per Session, £13 for six months, £7 for three months, or £2 10s. per month.

Students are supplied with a working table containing the ordinary reagents required for analysis, and such apparatus as retort stands, gas jets, &c. Small articles, such as Berlin porcelain evaporating basins, funnels, retorts, flasks, beakers, &c., Students are required to provide for themselves. Larger and more expensive apparatus, such as large evaporating basins, retorts, flasks, bottles, funnels, thermometers, &c., are lent for experiments. Students must be sixteen years of age on application, of good moral character, and, in addition to the ordinary branches of an English education, must be acquainted with the elementary principles of Chemistry. Further information may be obtained of the Professor, at the Laboratory, Anderson's University, 234, East George Street.

Bursaries.—The Trustees of the "Young" Chair have the superintendence of the Bursaries—regulating the appointment and terms on which they shall continue to be held. The Bursaries are of the amount of £50 each per annum, tenable for three years, during which the Bursars shall be required to give their whole time and attention to the Lectures and Laboratory duties of the "Young" Chair, paying the ordinary fees.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Mr. R. R. Tatlock, F.C.S.

SCHOOL OF CHEMISTRY.

42, BATH STREET, GLASGOW.

Dr. Wallace, Mr. Tatlock, and Dr. Clark.

CHEMICAL LABORATORY AND CLASS ROOMS.

144, WEST REGENT STREET, GLASGOW.

Conducted by Dr. Milne.

The Laboratory is open daily from 10 to 4 (Saturdays excepted), for Instruction in Practical and Analytical Chemistry. Fee for six months, exclusive of apparatus, £10 10s. Fee for one month, £2 2s. Private Pupils (number limited to three), per month, £4 4s. Students can join the Laboratory at any time.

The Practical Evening Classes for Instruction in Analysis and Testing will meet on Tuesdays and Thursdays, from 7 p.m. till 9 p.m., commencing November 3. Fee for one night per week, including apparatus and material, £1 1s. per quarter. Fee for two nights per week, £2 2s.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.R.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND.

STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete Course of Instruction in Science, applicable to the Industrial Arts. The subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical and Practical Chemistry.—R. Galloway, F.C.S.

Professor of Experimental Physics.—W. F. Barrett, F.R.S.E., F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Each Student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year, The Exhibitions are awarded at the Annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three year's course.

The Session commences on Monday, October 5th.

CORRESPONDENCE.

A READY METHOD OF DETECTING MEAT-FATS MIXED WITH BUTTER.

To the Editor of the Chemical News.

SIR,—As far back as November and December, 1861, I published in the CHEMICAL NEWS several papers on this subject, which at the time created some discussion between myself and Dr. Ballard, and as the other day when I was in London I heard that the practicability of my method was disputed, and that the question of fats in butter was still unsolved, I have since directed further attention to the matter, and am happy to say that I have been eminently successful.

My starting-point was that fresh butter was permanently soluble in methylated ether, sp. gr. 0·730, at the temperature of 65° F. But with the view of seeing if any other substance it may contain could be precipitated from it, I took, say, 20 or 25 grains of fresh butter, placed it in a small test-tube, and poured over it 1 dram of methylated ether, and on corking the tube it readily dissolved after a few moments agitation. I then added 30 drops of methylated alcohol, 63° O.P., and agitated again, but nothing was precipitated. I therefore made another experiment with 15 grains of fresh butter, and 10 grains of prepared mutton fat, dissolved them in 1 dram of ether first, and added 30 drops of alcohol, when in less than half an hour the fat was precipitated, in a room heated to 680° F.

Next, in order to see the effect upon mixtures of known fats, such as lard, beef, mutton, and tallow fats, properly melted together in proportions of 60 grains of butter and 40 of fat, and stirring till cold, I found that each of them could, by a similar procedure, be precipitated in a few minutes.

In one case, that of mutton, I filtered off the etherial liquid, and collected the residue, and obtained as much as 30 per cent of what had been used; so that there is no longer any doubt about easily detecting fatty adulterations in butter.

I have exhibited my experiments before various tradespeople, and all have expressed delight at their success.

Something has recently been stated by certain parties as to the estimation of butyric acid; but for my part, I do not think much of that, seeing that we can now deal with the fats in such a simple and more direct way. Lastly, I would observe that crystallisation of butter out of the etherial solution at a lower temperature than 65°, must not be mistaken for the fats precipitated by alcohol alluded to, as the butter, besides being so much lighter, occupies the upper layer, and is different in character, and easily re-melted by the application of the warm hand for a minute or so.—I am, &c.,

John Horsley, F.C.S.
Analyst to the County and
City of Gloster.

Cheltenham, September 4, 1874.

NOTES AND QUERIES.

Pyro-Naphthalin.—Will you or some of your numerons correspondents kindly inform me from what source pyro-naphthalin is prepared, and how? stating also the uses of the same, and any additional information. The above will greatly oblige.—M. D.

TO CORRESPONDENTS.

⁂ Vol. XXIX. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxx. commenced on July 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Royal Veterinary College.—Opening of the WINTER SESSION.

The LECTURES at this Institution will COMMENCE on THURSDAY, October 1.

The Chair will be taken by C. N. NEWDEGATE, Esq., M.P., who will distribute the medals, &c., to the successful candidates for the Coleman Prize, and also the certificates to the office-bearers of last Session.

The Introductory Address will be delivered by Professor Tuson, at one o'clock.

Lectures, Clinical and Pathological Demonstrations, and General Instruction are given on Pathology of the Horse and other domesticated animals, including Epizootics, Parasites, and Parasitic Diseases; also on Anatomy, Physiology, Histology, Chemistry (General and Practical), Materia Medica, Toxicology, Botany, Therapeutics, and Pharmacy, Hospital Practice, Obstetrics, Operative Surgery, the Principles and Practice of Shoeing, &c.

Students are required to attend one Summer and two Winter Sessions at least before being eligible for Examination for the Diploma of the Royal College of Veterinary Surgeons.

The Matriculation Examination is conducted by the College of Preceptors. Fee, One Guinea.

College entrance fee, Twenty-five Guineas; the payment of which confers the right of attendance on all the Lectures and Collegiate Instructions, with the exception of Practical Chemistry.

The Matriculation Examination of pupils will take place on September 29, at ten a.m.

Candidates who elect to be examined on any of the voluntary subjects are requested to inform the Principal of such intention, and to name the subject not later than September 20.

A Prospectus, containing the rules of the College and copies of the examination papers set last September, will be forwarded on application to the Principal.

A Life Subscriber of Twenty Guineas, or one of Two Guineas annually, to the institution is entitled to have admitted into the Infirmary for medical and surgical treatment an unlimited number of horses or other animals, his own property, at a charge only for their keep. Also to have the opinion of the Professors as to the treatment of any animal he may desire to retain in his own possession without the payment of fees.

JAMES B. SIMONDS, Principal.

August 17, 1874.

University of Aberdeen.—Chancellor, His Grace the Duke of Richmond. *Vice-Chancellor and Principal,* the Very Rev. P. C. Campbell, D.D. *Lord Rector,* T. H. Huxley, LL.D., F.R.S.

FACULTY OF MEDICINE—SESSION 1874-75.

WINTER SESSION, Commencing on Wednesday, October 28.

Anatomy—Professor Struthers, M.D. 11 a.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and Demonstrator. 9 to 4, and 9 a.m. £2 2s.
Chemistry—Professor Brazier. 3 p.m. £3 3s.
Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.
Surgery—Professor Pirrie, C.M., .FR.S.E. 10 a.m. £3 3s.
Practice of Medicine—Professor Macrobin, M.D. 3 p.m. £3 3s.
Midwifery and Diseases of Women and Children—Professor Inglis, M.D. 2 p.m. £3 3s.
Zoology with Comparative Anatomy—Professor Nicol, F.G.S. 2 p.m. £3 3s.
Medical Logic and Medical Jurisprudence—Professor Ogston, M.D. 9 a.m. £3 3s.

SUMMER SESSION, Commencing on the First Monday of May.

Botany—Professor Dickie, M.D. 9 a.m. £3 3s.
Materia Medica (100 lectures)—Professor Harvey, M.D. 3 and 4 p.m. £3 3s.
Practical Pharmacy—Professor Harvey and Assistant. £2 2s.
Practical Anatomy and Demonstrations—Professor Struthers and Demonstrator. 9 to 4, and 2 p.m. £2 2s.
Practical Chemistry—Professor Brazier. 10 a.m. £3 3s.
Zoology with Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.

The Anatomical Course in Summer includes instruction in General Anatomy and in the use of the Microscope; and instruction in Osteology for Beginners.

Matriculation Fee (including all dues) for the Winter and Summer Sessions, £1. For the Summer Session alone, 10s.

Pathological Anatomy—Dr. Rodger. £2 2s.

Practical Ophthalmology—In Summer, Dr. A. D. Davidson.

Dental Surgery—In Summer, Mr. Williamson.

Royal Infirmary: Daily at Noon. Physicians—Drs. Smith-Shand, Beveridge, and A. Fraser. Surgeons—Drs. Pirrie, Kerr, and Ogston. Junior Surgeon—Dr. Will. Ophthalmic Surgeon—Dr. A. D. Davidson. Dental Surgeon—Mr. Williamson. Pathologist—Dr. Rodger. Pepetual Fee to Hospital Practice, £6; or, first year, £3 10s.; second year, £3.

Clinical Medicine—Drs. Smith-Shand, Beveridge, and A. Fraser. £3 3s.

Clinical Surgery—Drs. Pirrie, Kerr, and Ogston. £3 3s.

General Dispensary and Lying-in and Vaccine Institution: Daily. Eye Institution: Daily.

Practical Midwifery, under the superintendence of Dr. Inglis.

Royal Lunatic Asylum: Physician—Dr. Jamieson. Clinical Instruction is given for Three Months in the Year.

The Regulations relative to the Registration of Students of Medicine, and the granting of Degrees in Medicine and Surgery, may be had of Dr. Macrobin, Dean of the Faculty of Medicine.

Full information regarding the Classes and Degrees in the Faculties of Arts, Law, and Divinity, and in regard to Bursaries and Scholarships, will be found in the UNIVERSITY CALENDAR, published by Messrs. Wyllie & Son, Union Street, Aberdeen.—By post, 2s. 2d.

Royal College of Science for Ireland, Stephen's GREEN, DUBLIN.

SCIENTIFIC AND TECHNICAL EDUCATION.

This College supplies a complete course of instruction in Science, applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course.

There are Four Royal Scholarships, of the value of £50 each yearly, with free education, including Laboratory instruction, tenable for two years. Two become vacant each year. They are given to Students who have been a year in the College.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory.

Chemistry (Theoretical and Practical), Metallurgy, &c.—Professor Robert Galloway, F.C.S.
Mathematics, Mechanics, and Mechanism—Professor Robert Ball, LL.D., F.R.S.
Drawing, Engineering, and Surveying—Professor Thomas F. Pigot, C.E., M.R.I.A.
Experimental Physics—Professor W. F. Barrett, F.R.S.E., F.C.S.
Geology—Professor Edward Hull, M.A., F.R.S.
Mining and Mineralogy—Professor J. P. O'Reilly, C.E., M.R.I.A.
Agriculture—Professor Edmund W. Davy, M.D., M.R.I.A.
Botany—Professor W. R. M'Nab, M.D.
Zoology—Professor H. Alleyne Nicholson, M.D.

The Session commences on Monday, October 5th.

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D., Secretary.

THE CHEMICAL NEWS.

Vol. XXX. No. 773.

NOTES ON THE OCCURRENCE OF ALUMINIUM IN CERTAIN CRYPTOGAMS.

By Professor A. H. CHURCH, M.A.

All the more recent and exact analyses of the ashes of plants show that the element aluminium is not to be found amongst the constituents of flowering plants, and that its presence is confined to a few of the cryptogams. During the last two years I have been endeavouring to give greater precision to our knowledge of this subject, and through the kindness of various friends, including Dr. Hooker, of Kew, and Dr. McNab, of Dublin, I have been enabled to secure authentic specimens of the different species of plants which I deemed it important to analyse. My researches are by no means finished, but I have obtained results of so interesting and decisive a bearing that I think they should be made known at once, even if incomplete.

In undertaking an enquiry of this nature, there are three conditions of success which must be rigorously fulfilled: the plants must be absolutely freed from all extraneous matter previous to incineration; the process for the determination of the alumina must be accurate, and must not allow traces of this earth to escape precipitation; and the reagents and apparatus must not introduce any alumina. The first condition was fulfilled by a system of washing and brushing the various plants operated upon, and analysing the material experimented on in different stages of purification; it may be noted here that, in the case of the plants in which aluminium occurs, more was invariably found in the completely washed than in the partially washed samples. The second condition was answered by the use of the well-known sodium hydrate and barium chloride process, as described in my "Laboratory Guide," 3rd edition, p. 137; while the third condition merely required the use of pure reagents, such as sodium hydrate made from sodium, and of silver vessels instead of those of glass generally employed.

Before giving my chief results, a word must be said as to the work already done in this direction. So far as I know, aluminium has not been detected in the ashes of any plants save four, or possibly five, and in one or two of these cases we lack information as to the purity of the reagents employed; indeed, in most of them we may be sure that the sodium hydrate was *not* prepared from pure sodium. On this account, I could not regard the recorded discovery of 1 or 2 per cent of Al_2O_3 in the ash of some of the plants analysed as conclusive of the occurrence of this constituent amongst those essential to the plant itself. For instance, in 1856, Solms Laubach (*Ann. Chem. Pharm.*, c., 297) found in the ash of the *Lycopodium denticulatum* of gardens (really a *Selaginella*, the *S. Kraussiana*, of Kunze) 42 per cent of silica and 2·0 per cent of alumina, a small proportion, it will be seen, of the latter earth, and one due very likely to its introduction from the reagents and the glass vessels used. But when Ritthausen (*Journ. Prakt. Chem.*, lviii., 13), in 1853, found 39·07 per cent of alumina in the ash of *Lycopodium chamæcyparissus*, and 20·69 per cent in that of *L. clavatum*, it was obvious that there was no room to doubt the fact that alumina formed an important part of the fixed constituents of the plants analysed. Further, the above results confirmed others previously obtained (1851 and 1852), and have met since with general acceptance. What I have at present done has been to examine other species of the same genus, *Lycopodium*, and a few plants belonging to closely-allied genera.

My first experiments were made upon two British Lycopodia, *L. clavatum* and *L. alpinum*, abundant supplies of these club-mosses in fruit having been obtained from a mountain district in Westmoreland. A quantity of plants of each species was cleansed by careful brushing, and the material thus prepared was burnt and the ash analysed. Other portions were then brushed and washed in a stream of cold distilled water, and then burnt, the ash being examined as in the first instance. A third portion of each kind was then purified by the most thorough brushing and washing, so that every particle of foreign matter was entirely removed. The ash in the samples which had been brushed merely, and in those also which had been further purified, was greater in amount, but contained *less alumina*, than the ash of the completely purified samples. As further washing neither lessened the ash, nor increased its percentage of alumina, it was considered that all extraneous matter had been removed. The following percentages were finally obtained:—

	Percentage of Ash in Dry Plant.	100 parts of Ash contained	
		Al_2O_3.	SiO_2.
Lycopodium alpinum ..	3·68	33·50	10·24
L. clavatum	2·80	15·24	6·40

These results really agree with those of Ritthausen; for *L. alpinum* is a species closely allied to *L. chamæcyparissus*, in which he detected 39·07 per cent of Al_2O_3, while my determination in the case of *L. clavatum* is not much lower than his, viz., 15·24 per cent of Al_2O_3 in lieu of 20·69.

The next point to be settled was the absence or presence of alumina in the species of the closely allied genus *Selaginella*. I obtained a good supply of *S. Martensii*, var. *robusta* (the var. γ *compacta* of A. Braun), and thoroughly cleansed it previous to analysis. It gave—

	Percentage of Ash in Dry Plant.	100 parts of Ash contained	
		Al_2O_3.	SiO_2.
Selaginella Martensii } ..	11·66	0·26	41·03

Practically, this ¼ per cent of Al_2O_3 must be regarded as accidental, and we may conclude that this constituent is absent from the plant in question.

Further, to see whether alumina is really distinctive of *Lycopodium*, and is always absent from *Selaginella*, other trials were made. A quantity of another species of *Lycopodium*, *L. Selago*, was obtained from Westmoreland, and cleansed and burnt with the following results:—

	Percentage of Ash in Dry Plant.	100 parts of Ash contained	
		Al_2O_3.	SiO_2.
L. Selago	3·20	7·29	2·53

A result perfectly confirming my former conclusions, and the more particularly so, as the group of Lycopodia to which *L. Selago* belongs is separated from the group to which *L. alpinum* belongs by that to which *L. clavatum* belongs, thus:—

Botanical Series.		Order. According to Percentage of Alumina.	
1. ..	*L. alpinum.*	1.	33·50
2. ..	*L. clavatum.*	2.	15·24
3. ..	*L. Selago.*	3.	7·29

Now there is a most interesting British *Selaginella*, the only species found in these islands, and a plant which has been ranged amongst the *Lycopodia* until the last few years, when it was separated on account of its mode of reproduction. This plant, formerly known as *Lycopodium selaginoides*, is now called *Selaginella spinulosa*. If the element aluminium be really confined to the genus *Lycopodium*, this plant ought not to contain it—and it does not, according to the following analysis:—

	Percentage of Ash in Dry Plant.	100 parts of Ash contain	
		Al_2O_3.	SiO_2.
Selaginella spinulosa ..	3·44	none	6·67

A good supply of this plant was kindly obtained for me from Largo Links, Fife, by Mr. Howie, of Largo.

Many points remain to be determined by further research concerning this occurrence of aluminium in species of *Lycopodium*. Is the proportion in any one kind as fairly constant in quantity as the other constituents of the ash? Is the element present in every kind of *Lycopodium?* I have commenced the study of another point connected with the present inquiry, and have searched for and failed to find alumina in the ashes of the following cryptogams, more or less nearly related to *Lycopodium*:—

Equisetum maximum.
Ophioglossum vulgatum.
Psilotum triquetrum.

I hope to analyse species of *Phylloglossum* and *Tmesipteris*, two genera of *Lycopodieæ* closely allied to *Lycopodium*. *Isoetes*, also, which is separated from *Lycopodium* by *Selaginella*, should also be studied in this connection.

In the following table, the results recorded in the present paper are presented in a compact form:—

	Percentage of Ash in Dry Plant.	100 parts of Ash contain	
		Silica.	Alumina.
Lycopodium alpinum ..	3·68	10·24	33·50
L. clavatum	2·80	6·40	15·24
L. Selago	3·20	2·53	7·29
Selaginella Martensii ..	11·66	41·03	0·26
Selaginella spinulosa ..	3·44	6·67	none
Equisetum maximum ..	20·02	62·95	none
Ophioglossum vulgatum	8·25	5·32	none
Psilotum triquetrum ..	5·06	3·77	trace (?)

ON THE COMPOSITION OF AN INFLAMMABLE GAS ISSUING FROM THE SILT-BED IN BELFAST.

By Dr. ANDREWS, F.R.S.

In sinking for a well upon the premises of Messrs. Cantrell and Cochrane, in George's Lane, Police Square, Belfast, after having passed through a deposit of silt to the depth of 33 feet, a layer of gravel was reached, seven feet in thickness, and containing a quantity of organic *debris*. It rested upon a thick deposit of very tenacious clay. On entering the gravel-bed, a large flow of water occurred, which rose to within four feet of the surface of the ground, and interrupted the operation of boring, till a pump, worked by a small steam-engine, was erected, which, so long as it was in action, kept the boring free from water as far as the surface of the gravel-bed. A workman, having lowered a light to examine the bottom of the well, was surprised to see a lambent flame playing over the surface. On examination, this was found to arise from a disengagement of inflammable gas, which had accumulated between the lower surface of the bed of silt and the layer of gravel.

An iron pipe terminating in a funnel-shaped mouth, about one foot in diameter, was now sunk till it reached the gas stratum, and the water in the well was kept by pumping at such a level that an extra pressure of about one inch of water was maintained upon the gas below. The gas now flowed freely, at the rate of about 40 cubic inches per minute, through the upper end of the iron pipe, and when ignited, burned with a yellow flame, which could scarcely be distinguished from that of ordinary coal gas.

Two portions of the gas were carefully collected by displacement, the stream of gas being allowed to pass till the whole of the atmospheric air in the vessels was completely swept away. The connecting tubes were then carefully sealed, and the gas was afterwards analysed in the laboratory of Queen's College.

A measured volume of the gas, standing over mercury, was exposed to the action first of caustic potash, and afterwards of pyrogallic acid; the residual gas on analysis gave the following results:—

	V.	T.	B.	C.
Atmospheric air	78·7	12·2	770·9	308·8
Residual gas added ..	120·5	12·4	771·5	272·2
Oxygen added	190·0	12·1	771·8	221·8
After explosion	126·5	13·0	771·7	271·6
Carbonic acid absorbed	90·0	11·8	772·0	299·7

In this table V is the volume of the gas; T its temperature in centigrade degrees; B the height of the barometer in millimetres; and C the height of the mercury in the tube in which the observations were made. From these data and the results of the previous action of the caustic potash and pyrogallic acid, it follows that the composition of the gas was:—

Marsh gas (CH_4)	83·75
Carbonic acid	2·44
Oxygen	1·06
Nitrogen	12·75

The density of the gas (air = 1) was found to be 0·661, which corresponds nearly to the foregoing composition. The gas was inodorous and contained no compound of carbon and hydrogen except marsh gas.

From this analysis it is evident that the gas formed in this subterranean sheet of water is in all respects the same as that which is produced in stagnant pools containing leaves and other vegetable matters.

REPORT OF THE COMMITTEE ON SIEMENS'S PYROMETER.*

The following is a summary of the Report presented by the Committee:—

Four pyrometers supplied by Dr. C. W. Siemens have been examined; they were numbered by the makers 404, 411, 414, and 445, respectively. In No. 404 the coil of platinum wire—upon the change of whose electrical resistance the indications of the instrument depend—was protected from the fire only by a wrought-iron tube closed at one end; in Nos. 411 and 414, there was a piece of platinum foil round the coil inside the iron tube; in No. 445, the part of the iron tube which in the other pyrometers was exposed to the fire was replaced by a tube of platinum, but this instrument, like all the rest, had a long stem formed of a wrought-iron tube, about 1½ inch diameter, meant to project from the furnace.

The experiments consisted in repeatedly heating the pyrometers to redness in a common open fire-place (without blower), and ascertaining their electrical resistance at 10° C. before and after this treatment. The measurements were made when the part of the pyrometer containing the [illegible] immersed in water of known temperature, whi[illegible]ways nearly that of the atmosphere at the time, a[illegible]sults were reduced to 10° by means of a coefficient determined by experiment. This method was preferable to attempting to bring the pyrometer always to the same temperature by means of ice, since the thermal conductivity of the wrought-iron stem made the temperature of the coil uncertain whenever there was much difference between the temperature of the atmosphere and that to which the coil was exposed. The resistances were measured by means of a Wheatstone's Bridge.

The final results were as follows:—

Pyrometer.	Resistance at 10° C.		Change of Resistance at 10° C.	Equivalent Change of Temperature
	Before Heatings.	After Heatings.		
No. 404.	9·917	10·749	+0·832	+30° C.
" 411.	9·988	11·596	+1·608	+58° C.
" 414.	9·920	11·089	+1·169	+43° C.
" 445.	10·105	10·059	−0·046	−1·5° C.

Hence, it appears that pyrometers constructed like the first three, that is, with an iron tube surrounding the coil of platinum wire, cannot be relied upon to give constant results; but that No. 445, in which the use of iron to protect the coil is entirely avoided, is sufficiently constant for most industrial applications.

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* Read before the British Association, Belfast Meeting, Section B.

The experiments were made in the Physical Laboratory of University College, by Professor G. C. Foster, or under his supervision.

ON A SESQUISULPHIDE OF IRON.*

By Dr. T. L. PHIPSON, Ph.D.

THIS is a substance of a beautiful dark emerald green colour, having the composition of Fe_2S_3, produced when ferric chloride is added to a solution of sulphide of ammonium containing a certain quantity of hypochlorite of soda, or whenever a per-salt of iron, containing free chlorine, or a hypochlorite is precipitated by sulphide of ammonium. In both cases, the sulphide of ammonium must have acquired, by age, the ordinary yellow tint.

The sesquisulphide of iron forms a dark green flocculent precipitate, appearing quite black when collected on a filter and washed. Its fine green colour becomes apparent when, after drying, it is ground up with a perfectly white powder such as chalk. Its properties are rather remarkable. It is soluble, to a notable extent, in water containing ammonia, and separates therefrom as the ammonia escapes; it is even soluble in alcoholic ammonia, forming in each case a bright emerald green solution, perfectly clear, and which can be filtered. It is only slightly soluble in a mixture of sulphide of ammonium and hypochlorite solution rather diluted; neither is it more than slightly soluble in either of these substances alone. It is more easily dissolved by hot water containing free ammonia.

In hydrochloric acid, it dissolves with smart effervescence of sulphuretted hydrogen, *immediately* producing perchloride of iron, Fe_2Cl_3, in spite of the abundance of sulphuretted hydrogen present. On analysis, it is found to be a hydrated sesquisulphide of iron, answering very nearly to the formula $2Fe_2S_3+3HO$.

ON THE

EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON AND STEEL BARS, AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.†

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Concluded from p. 106.)

The Coefficients of Elongation and of Retraction of Seven Rods of Different Species of Iron, and of Three Steel Rods of Various Degrees of Hardness.

It remains to give the determinations I have made of the coefficients of elongation and of retraction. Those measures were made on rods of circular sections, 60·1 inches long and 0·5 inch in diameter. As previously stated, the iron rods were thoroughly annealed, and the steel rods were carefully tempered. On the ends of the rods numbers were stamped, and these marks corresponded to the rods as follows:—

1.	Scrap iron.
2.	Ulster iron.
3.	Norway iron.
4.	English refined iron.
5.	Low Moor iron.
6.	Fall River iron.
000.	Steel soft.
00.	Steel hardened and drawn to blue.
0.	Steel hardened and drawn to yellow.

The method of determining the coefficients was as follows:—When the rod had attained a fixed temperature, so that the scale-reading remained constant for an hour, I recorded this scale-reading. I then passed the current from the 25-cell battery, and so soon as the new scale-reading then produced was read, I broke the circuit and obtained the corresponding scale-reading. These readings were now written in the note-book, and immediately after recording them I again made and broke the circuit, and noted the two corresponding readings of the telescope-scale. I then continued making and breaking the circuit and recording the scale divisions, until the rod began to elongate from the heat produced on demagnetisation.

The tables I here present consist of six columns, A, B, C, D, E, and F. Under A are designated the rods; B contains the elongations or retractions produced on first passing the current; C the retractions or elongations observed after the first made circuit had been broken; D the permanent elongations or retractions observed in the rod after the first circuit passed had been broken; E the elongations or retractions produced on making the second and subsequent circuits; F the elongations or retractions produced on breaking the second and subsequently formed circuits.

Table of the Elongations and Retractions of the Rods.

TABLE I.

Elongations and Retractions in Units of the Telescope-Scale.

A. Rod.	B. First Make-Circuit.	C. First Break-Circuit.	D. Permanent *e* or *r*.	E. Second Make-Circuit.	F. Second Break-Circuit.
1	1·25 *e*†	·75 *r*	·4 *e*†	·7 *e*†	·7 *r*†
2	1·6 *e*	1·2 *r**	·4 *e*†	1·2 *e*	1·2 *r*
3	2·0 *e*	·9 *r*	1·1 *e*	1·4 *e**	1·4 *r**
4	2·5 *e**	1·15 *r*	1·35 *e**	1·15 *e*	1·15 *r*
5	1·65 *e*	·6 *r*†	1·05 *e*	1·0 *e*	1·0 *r*
6	1·4 *e*	·85 *r*	·55 *e*	·9 *e*	·9 *r*
000	·8 *e**	·6 *e**	1·4 *e**	·25 *r*	·25 *e*
00	·25 *r*	·5 *e*	·25 *e*	·5 *r**	·5 *e**
0	·4 *r*†	·25 *e*†	·15 *r*†	·2 *r*†	·2 *e*†

TABLE II.

Elongations and Retractions in Fractions of an Inch.

A.	B.	C.	D.	E.	F.
1	·0001375	·0000825	·000044	·000077	·000077
2	·000176	·000132	·000044	·000132	·000132
3	·000220	·000099	·000121	·000154	·000154
4	·000275	·0001265	·0001485	·0001265	·0001265
5	·0001815	·000066	·0001155	·000110	·000110
6	·000154	·0000935	·0000605	·000099	·000099
000	·0001168	·0000876	·0002044	·0000365	·0000365
00	·0000365	·0000730	·0000365	·0000730	·0000730
0	·0000584	·0000365	·0000219	·0000292	·00002[illegible]

TABLE III.

Coefficients of Elongations and of Retractions.

A.	B.	C.	D.	E.	F.
1	·000002283 *e*†	·000001377 *r*	·000000732 *e*†	·000001281 *e*†	·000001281 *r*†
2	·000002928 *e*	·000002196 *r**	·000000732 *e*†	·000002196 *e*	·000002196 *r*
3	·000003660 *e*	·000001647 *r*	·000002013 *e*	·000002562 *e**	·000002562 *r**
4	·000004575 *e**	·000002105 *r*	·000002471 *e**	·000002088 *e*	·000002088 *r*
5	·000003019 *e*	·000001098 *r*†	·000001921 *e*	·000001830 *e*	·000001830 *r*
6	·000002562 *e*	·000001555 *r*	·000001006 *e*	·000001647 *e*	·000001647 *r*
000	·000001943 *e**	·000001457 *e**	·000003400 *e**	·000000607 *r*	·000000607 *e*
00	·000000607 *r*	·000001212 *e*	·000000607 *e*	·000001212 *r**	·000001212 *e**
0	·000000972 *r*†	·000000607 *e*†	0·000000364 *r*†	·000000486 *r*†	·000000486 *e*†

* Maximum. † Minimum.

After the quantities given in the columns, I have written *e* to designate the *elongation* of the rod, and *r* to indicate its *retraction*.

I have given the measures in three tables. Table I. contains the elongations and retractions in the actual scale units. It is here to be remembered that one division of the scale equals 0·0001 of an inch for the experiments on rods No. 1 to No. 6, inclusive; while for the remaining rods, 000, 00, and 0, one division of the scale equals

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* Read before the British Association, Belfast Meeting, Section B.

† Read before the National Academy of Sciences, Cambridge, U.S.

0·000146 of an inch. Table II. gives the elongations and retractions of Table I. expressed in fractions of the inch of "Troughton's scale."[*]

Table III. contains the coefficients calculated from the numbers given in Table II.

Certain numbers of the tables are followed by * or by †; * indicates the maximum effect observed in the iron, or in the steel rods, corresponding to the phase of experiment given in the heading of the columns of Table I., or as subsequently designated by A, B, C, D, &c. An examination of the tables shows that the maxima and minima effects, in the case of the iron rods, are very irregularly distributed. Thus, corresponding to the "first make-circuit," we find that rod No. 4 gives the maximum, while rod No. 1 the minimum. On the "first break-circuit," rod No. 2 is the maximum, while rod No. 5 is the minimum. For the "permanent elongation," rod No. 4 is the maximum, and rods No. 1 and 2 are the minima. In the two columns corresponding to "second make-circuit" and "second break-circuit," we see that rod No. 3 gives the maximum effect observed, while rod No. 1 gives the minimum.

The Phenomena of Elongation and Retraction observed in Rods of Steel.

The phenomena observed in the magnetisation and demagnetisation of the rods of steel have not been referred to. Here we have presented to us remarkable results. On first passing the current around rod 000, of soft steel, it elongated 0·8 of a scale-division, behaving like a rod of soft iron; but, on breaking the circuit, to my astonishment, it again *elongated* 0·6 of a div., thus leaving this rod with a permanent elongation of 1·4 divs.; and this elongation exceeds the permanent elongation given to any of the soft iron rods when similarly experimented on. On passing the current around the rod, *for the second time*, the soft steel rod again did not act like a rod of iron, for it *retracted* 0·25 of a div. instead of *elongating*, as did the rods of iron in like circumstances; and on breaking this circuit the rod *elongated* 0·25 of a div., instead of retracting; again exhibiting a phenomenon the reverse of those observed in the rods of iron; and it is here important to remark, that *all* of the steel rods behaved in the same manner on the making and breaking of the second and subsequently formed circuits.

The results just described differ from those obtained by Dr. Joule. Referring to his memoir (*Phil. Mag.*, vol. xxx., p. 85), we find that experiments on a rod of soft steel, one yard long and a quarter of an inch in diameter, showed that the rod elongated on first passing the current; but on breaking this circuit the rod *retracted*, while in my experiments the rod again *elongated* on breaking this circuit. Indeed, the experiments of Dr. Joule indicate that a rod of soft steel behaves like one of iron, except that the elongations and retractions are of less extent than in the case of an iron rod. It is important, however, to observe that Dr. Joule did not, in his first experiment on this rod, pass around it a current sufficient to "saturate" it, but gradually increased the intensity of the current in successive experiments; and it is to be remarked that, as the intensity of the current increased, the retractions and elongations came nearer and nearer to equality, but in no instance did he observe a *retraction* on passing a current and an *elongation* on its cessation.

In his subsequent experiments, Dr. Joule worked on a steel rod of the same dimensions as that used in his former experiment, but it was "hardened to a certain extent throughout its whole length, but not to such a degree as entirely to resist the action of the file." On *first* passing the current, and also in subsequently passing the current with successively increased intensities, he obtained results similar to those I observed in the rod of soft steel, but with this rod also he never observed a *retraction* on making a circuit, and an *elongation* on breaking it. The fact that so eminent an investigator as Dr. Joule obtained, on *first* passing a current around a bar of soft steel, results similar to those obtained by me with my bar of soft steel, leads me to suspect that the rod I experimented on may have retained some degree of "hardness" after it had been annealed; but even this fact granted, does not explain why *all* the steel rods I experimented on gave *retractions* on passing the current a *second* time after they had been "saturated" during the *first* passage of the current.

Examining the results of my experiments on rod 00, of hard steel "drawn to blue," we see that the phenomena are exactly the reverse of those occurring in rods of iron in the same circumstances, except in this one particular, viz., that after breaking the first made circuit the rod is permanently *elongated*; and this result agrees with all of those obtained by Dr. Joule.

The experiments on rod 0, of hard steel "drawn to yellow," are noteworthy. On making the *first* circuit, this rod *retracted* 0·4 of a div., and on breaking this circuit the rod elongated, but only 0·25 of a scale division, thus leaving the rod permanently *retracted* 0·15 of a div.; so that this rod of hard steel, which after the experiment remained a powerful magnet, is *shorter* than it was before it was magnetised. On passing the second current around this rod, it, like the two preceding rods, *retracted* 0·2 of a div., and on breaking this circuit it elongated by the same quantity, so that, after the second and subsequent passages of the voltaic current, it persisted in the retraction it received after the first made circuit was broken.

The experiments I have just given on rod 0 differ in every particular from any obtained by Dr. Joule on rods which were *not subjected to tractile strain*. I cannot but regret that this eminent physicist did not experiment on rods of very hard steel freed, as far as possible, from all strains; for then my experiments would have been strictly comparable with his. The experiments which Dr. Joule made on rods of hard steel (except those I have already quoted) were conducted on rods subject to tractions going from 80 lbs. up to 1030 lbs., while my experiments were made on rods so supported by brass springs that only a fraction of their weight was supported by the V's on which their ends rested.

Referring to Dr. Joule's experiments on a "soft steel wire, one foot long, a quarter of an inch in diameter, tension 80 lbs.," we find that this rod behaved like one of soft iron, free of strain, with currents deflecting his galvanometer 34° 40' up to 56° 30'; but with currents below 34° 40', no action whatever was observed to take place in the rod, except its magnetisation; but when the same rod was subjected to a tension of 462 lbs., and a current of 60° 15', it behaved like my horizontally suspended steel rod 00; that is, it retracted on making the circuit, but it elongated more than it had previously retracted when this circuit was broken. With a tension of 1680 lbs., the rod retracted and elongated by equal amounts on making and breaking the circuits. In Dr. Joule's experiments on a "hardened steel wire," one foot long, a quarter of an inch in diameter, tension 80 lbs., he observed no effect until the current reached an intensity of 45° 40'; then this rod also elongated and retracted by equal quantities on making and breaking the circuits. With a tension of 408 lbs. and of 1030 lbs. this rod behaved in the same manner, but the elongations and retractions did not begin to show themselves with the respective tensions until the currents had respectively reached the intensities of 60° 20' and 48° 33'. Summing up these results, Dr. Joule states :—"From the above experiments, we find that the induction of permanent magnetism produces no sensible effect on the length of a bar of perfectly hardened steel, and that the temporary shortening effect of the coil is proportional to the magnetism multiplied by the current traversing the coil. The shortening effect does not in this case sensibly increase with the increase of the tension." We have no reason to doubt the truth of this statement when applied to rods subject to tension, but my experiments show that when the rod ooo, of soft steel, and the rod oo, of hard steel "drawn to blue," were not subject to such strains, and indeed freed, as far as possible, from all strain, they were *permanently elongated* after they had received their permanent magnetism; and also, that the rod o, of hard steel "drawn to yellow," had a *permanent retraction* given to it with its permanent magnetic change.

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[*] "Two copies of the British standard, viz., a bronze standard, No. 11, and a malleable iron standard, No. 57, have been presented by the British Government to the United States. A series of careful comparisons—made in 1856, by Mr. Saxton, under the direction of Dr. Bache—of the British bronze standard, No. 11, with the Troughton scale of 82 inches, showed that *the British bronze standard yard is shorter than the American yard by 0·00087 inch.* So that in very exact measures with the yard-unit, it is necessary to state whether the standard is of England or of the English feet."—"Lecture Notes on Physics," by A. M. Mayer, p. 12. New York: Van Nostrand. 1868.

My experiments have been made with such conscientiousness, that at present I am not able to doubt the reality of these effects; but they should be repeated on fresh bars, and this I intend to do at some future day.

It is important that I should here call attention to the fact that the coefficients I have given in the appended tables are derived from measures on only *one* rod of each species of metal; and it may be that a considerable range in the elongations and retractions may be found in rods made of the same kind of iron or of steel. I hope to be able to present a new series of determinations of these constants, to be made with the apparatus already described, which employs the displacements of Newton's rings as a means of measuring the changes in the longitudinal and transverse dimensions of the rods.

When it is considered that the greatest motions, which have been the objects of my study, have their existence in the space of $\frac{1}{30000}$ths of an inch, while the smallest space within the limits of visibility of the most powerful microscope, being only $\frac{1}{200000}$ths (or 0·000005) of an inch, and furthermore, when it is known that the last-mentioned quantity equals the change in length of one of the rods caused by a variation of temperature of only $\frac{1}{300}$ths of a degree C., the difficulties I have conscientiously met and surmounted in this delicate research become manifest; but the very knowledge of those difficulties has tempered with modesty the confidence I feel in my work, and I will gladly accept any correction my measurements may receive from more experienced hands.

NOTES OF WORK
BY STUDENTS OF PRACTICAL CHEMISTRY
IN THE LABORATORY OF THE
UNIVERSITY OF VIRGINIA.
(No. III.)

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(Concluded from page 119).

(2). *Analysis of Allanite from a New Virginia Locality.* By Mr. J. Alston Cabell.

Several pieces of this mineral were brought me some months ago from a point in Amherst County in this State about fifteen miles west of Amherst Courthouse. The largest piece weighing a pound or two, and said to have been broken from a much larger mass, presented the appearance of a rough, imperfect fragment of a crystal, three or four inches long and wide, and an inch or inch and a half thick, showing imperfect external and cleavage planes. There was little adhering matrix, but such as remained consisted of decomposing felspar and a little quartz. The colour was black, with greasy and sub-resinous lustre on surfaces of fracture. Hardness between 5 and 6. Sp. gr. = 3·83. Easily decomposed by boiling hydrochloric acid of moderate strength.

Mr. Cabell obtained the following results of analysis, using considerable quantities of material for the detection and determination of the rarer earths, separating the cerium metals (after precipitation from the general solution as oxalates) by nitric acid and lead dioxide, as recommended by Dr. Wolcott Gibbs, and determining the water by direct weighing.

Silica	31·23
Alumina	16·45
Ferric oxide	3·49
Ferrous oxide	13·67
Cerous oxide	11·24
Lanthanum oxide Didymium oxide	9·90
Yttria	1·65
Glucina	0·24
Lime	8·69
Magnesia	0·22
Water	2·28
	99·06

If the water be supposed non-essential, and all the basic constituents except alumina and ferric oxide be taken as monoxides, these numbers lead to a fair approach to the general formula usually assumed for allanite, viz.—the same as that for garnet—

$$\left.\begin{matrix} R_3'' \\ R_2''' \end{matrix}\right\} Si_3O_{12},$$

the atomic proportions of $SiO_2 : RO : R_2O_3$ being 1 : 1·11 : 0·35 or 3 : 3·33 : 1·05 instead of 3 : 1 : 3 as required by this formula.*

It is worthy of notice, however, that if the cerium metals and yttrium be viewed as tri-atomic and their atomic weights altered accordingly, as lately urged by Cleve,† the analysis accords nearly as well with the regular formula of epidote, the species to which on crystallographic grounds allanite seems most closely related. Thus the epidote formula—

$$\left.\begin{matrix} R_6'' \\ R_8''' \end{matrix}\right\} Si_9O_{36} —$$

requires $SiO_2 : RO : R_2O_3 = 9 : 6 : 4$, while the above analysis gives the ratio 1 : 0·69 : 0·49 or 9 : 6·21 : 4·41.

(3). *Examination for Indium of Smithsonite from South-Western Virginia and Eastern Tennessee.* By Mr. John A. Tanner, of Linchburg, Va.

All the published statements, so far as I have seen them, referring to the occurrence of indium in nature speak of it as associated with zinc in *blende*.‡ Hence I proposed to Mr. Tanner to test for this rare metal the mixed carbonate and silicate of zinc worked in Wythe Co., Va., and Leadvale, Tenn., for some masses of which of considerable size I had been indebted to Mr. C. R. Boyd of Wytheville and Mr. H. S. Noble, of the Mercer Zinc Works. The ore consisted in each mainly of Smithsonite, but with no small admixture of calamine, and was partly compact, hard and sub-crystalline in structure, partly friable and earthy. One pound of the ore from each of the localities in question was coarsely pulverised and decomposed by hydrochloric acid, silica separated by evaporation to dryness and re-solution, a piece of metallic zinc known to be pure, digested in the liquid as long as any deposit formed (about six days), the precipitate scraped off, rapidly filtered and washed. This precipitate was then dissolved in dilute nitric acid, lead thrown down by sulphuric acid, and filtered off, the filtrate evaporated to drive off surplus nitric acid, slightly diluted and precipitated by sulphuretted hydrogen (which threw down cadmium and a trace of copper from each of the solutions). The filtrate was boiled, heated with a little potassium chlorate, precipitated with ammonia in excess, the precipitate re-dissolved in hydrochloric acid, and again precipitated with excess of ammonia. This precipitate was washed, digested with warm, dilute acetic acid, and sulphuretted hydrogen passed through the solution to saturation. The precipi-

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[*] In the calculation it has been assumed that lanthanum and didymium are present in equal amount, the mean of the two atomic weights being used.

[†] *Bull. de la Soc. Chim. de Paris*, 5 Mars, 1874, [illegible] 1874, p. 246; 20 April, 1874, p. 344.

[‡] Hoppe-Seyler reports [illegible] zinc (in [illegible] combination?) in wolfram. [illegible] for [illegible] are recorded by [illegible] American blende [illegible]

tate now thrown down by H_2S was filtered, well washed, warmed with a drop or two of nitro-hydrochloric acid, the liquid evaporated almost to dryness and tested before the spectroscope. The result was that the residue so obtained from a pound of the Virginia ore gave but a very faint and doubtful indication of the presence of indium, but in the case of the Tennessee ore the principal blue line (*a*) was unmistakably seen, the test being repeated several times. The quantity of the rare metal present was no doubt excessively minute.

The first sulphuretted hydrogen precipitate, and the filtrate from the second, were examined before the spectroscope, but afforded no further trace of indium.

(4). *Experiments to Determine the Effect of the Carbon contained in Iron-Wire upon the use of the latter in Standardising a Solution of Potassium Permanganate.* By Mr. J. R. McD. Irby.

In connection with the extensive use of potassium permanganate in volumetric analysis, perhaps the most common method of determining the strength of the solution of this salt when accurate results are desired, consists in dissolving in dilute sulphuric acid a known weight of fine iron-wire, and observing how much of the permanganate this iron solution will decolourise. This is specially recommended by Fresenius,[*] who draws attention to the fact that the best iron-wire does not represent chemically pure iron, but contains on an average 0·3 per cent of foreign matter, and hence advises that the amount of wire actually weighed shall be multiplied by 0·997 in calculating the strength of the solution. This correction of course involves the assumption that the impurities of the iron simply diminish the amount of this metal really present, and have no other influence upon the process. It seemed last autumn to have been overlooked that the chief impurity in wrought-iron is carbon, and that when separated in a state of extremely fine subdivision, this might itself quite possibly exert a reducing action upon the permanganate, and if so that (taking into account the low atomic weight of carbon as compared with iron) the correction required might be additive instead of subtractive and to a greater amount than the actual weight of foreign matter in the iron. Mr. Irby proposed to himself to examine this point, and had nearly completed the experiments, when attention was drawn to the matter by Berthelot,[†] whose paper of course divests the subject of novelty, but as he has not recorded any actual results of quantitative experiment, it seems well to publish some of the figures obtained here, omitting others which simply went to confirm the general conclusion.

In one instance a solution of permanganate was prepared, which, standardised by pure oxalic acid, was found of such a strength that 0·1 grm. of Fe = 18·15 c. c. of solution. 1·0407 grms. of bright, fine, piano-forte wire was dissolved in dilute sulphuric acid in a small flask. The solution was well mixed, and allowed to stand until quite clear, the foreign matter, consisting of some little black flocks, having settled to the bottom. The flask with its contents was weighed, and three successive portions of the solution were decanted off clear of carbon into other flasks, the loss of weight being each time ascertained—the remaining portion of solution contained all the carbon of the whole. All proper precautions were taken to prevent oxidation by contact with the air. The amount of permanganate solution decolourised by each of the four portions was now determined.

The first portion of iron solution of 13·125 grms. took 52·05 c.c. of permanganate.

The second portion of iron solution of 12·887 grms. took 51·20 c.c. of permanganate.

The third portion of iron solution of 11·618 grms. took 46·15 c.c. of permanganate.

Hence—

From the first portion of solution 0·1 grm. of Fe = 18·20 c.c. of permanganate.

From the second portion of solution 0·1 grm. of Fe = 18·25 c.c. of permanganate.

From the third portion of solution 0·1 grm. of Fe = 18·25 c.c. of permanganate.

Agreeing well with the determination by oxalic acid.

The fourth portion of iron solution (with suspended carbon) of 10·032 grms. took 43·70 c. c. of permanganate, but calculating from the mean of the preceding figures, this should have taken but 39·83 c.c. On reduction of ferrous sulphate (by means of zinc) and re-addition of permanganate it actually took 40 c.c. Thus the carbon of 1·0407 grms. of iron-wire reduced 3·7 c.c. of permanganate, and so did the work of 0·0203 grm. of Fe, or introduced an error equal to 1·95 per cent of the quantity weighed.

In another experiment, an attempt was made to isolate the carbonaceous residue, and determine the extent of its sole action upon the permanganate. 7·2194 grms. of iron wire was dissolved, the black flocculent residue filtered off, washed as carefully as possible, and treated with permanganate solution of same strength as above. 12·5 c.c. were decolourised = 0·0687 grm. of Fe = 0·95 per cent of the quantity weighed. In this case it is doubtful whether all the residue left by the acid was collected unoxidised in the first instance, and it was observed that the oxidation by the permanganate was incomplete, some black specks remaining floating on the liquid.

The above figures sufficiently prove that an error of from 1 to 2 per cent may be committed in standardising potassium permanganate by means of iron wire assumed to represent pure iron, and that the error is increased, instead of diminished, by assuming such wire to represent *less* than its weight of Fe.

(5). *Analysis of a Curious Specimen of Iron produced in connection with the Working of Heaton's Steel Patent.* By Mr. J. Alston Cabell.

The iron in question was from the sides of the reheating furnace used in preparing for the tilt-hammer the steel obtained by Heaton's process (action of Chili saltpetre upon fused cast-iron).

It was almost as white and lustrous as silver, showed little tendency to rust, and presented a remarkable appearance as of crystallisation, the mass being made up of granules ranging from an eighth to a quarter of an inch in diameter, on which faces suggesting those of the octahedron and dodecahedron were everywhere observable.

These faces, however, were nearly all of them more or less curved and contorted, and more careful examination seemed to show that the structure was in reality pseudo-crystalline only, as in the well-known cases of basalt, starch, &c. The mass would not bear much hammering without crumbling apart, the granules in question parting from one another without much difficulty, but each single granule proved to be tough and malleable, admitting of being flattened out easily enough upon the anvil. The iron could, moreover, be easily filed and sawed, and was not materially hardened by heating red-hot and suddenly cooling in water. It was, therefore, essentially wrought-iron, sp. gr. = 7·86. After a careful qualitative analysis, Mr. Cabell obtained the following quantitative results:—

Carbon	1·121
Silicon	0·024
Sulphur	0·037
Phosphorus	0·436
Iron (by difference)	98·382
	100·000

The large amounts of carbon and phosphorus are quite remarkable in connection with the malleability and incapability of being hardened of the metal, and its high specific gravity and curious structural character still further render it worthy of notice.

University of Virginia, July 20, 1874.

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[*] *Anleit. z. quant. Chem. Anal.*, 5th Aufl., S.S. 230—234.

[†] *Bull. de la Soc. Chim. de Paris*, 20 Janv., 1874, p. 58.

NOTICES OF BOOKS.

The Sanitary Condition of Oxfordshire. By Gilbert W. Child. London: Longmans, Green, and Co.

This report is one of the most valuable first-fruits of recent sanitary legislation. It throws a clear, but far from "rose-coloured" light upon the condition of average rural districts, villages, and small towns. Many statements which the British public hoped were exaggerated, and sensational, are here confirmed in the plainest and most matter-of-fact manner. Concerning the water we are told:—"It is really the exception to find in country districts a water supply which is at once plentiful and wholesome, and even tolerably accessible to the people. In a large number of towns and villages the drinking-water in use is in the very foulest condition." All this we can fully confirm from our own observation. We fear that the drinking-waters of the fen districts, and the eastern counties generally, are even worse than those which our author has met with in his district.

The cottages, from a sanitary point of view, are even worse. "I have entered many," says Mr. Child, "almost completely black, reeking of smoke and filth, damp, clammy, and noisome. I have constant cases brought before me in which six, eight, or ten people are sleeping in one such room as I have now faintly described."

The observations on the propagation of fever, and its evident close causal connection with nuisances, are very valuable. We find a curious instance where two petroleum barrels had been buried in the earth, and where a chain of wells extending over a distance of 189 yards were in consequence tainted with the nauseous flavour. This is an important case as showing the distance to which pollutions may penetrate through the soil.

As regards the disposal of excreta and domestic refuse, the author recommends, in preference both to cesspools, dry closets, and complete water sewage, the Milan system of water-tight cesspools, emptied by atmospheric pressure. He complains that this system is too often condemned on account of a clumsy imitation of it which exists in Paris. In Milan it is described as being completely successful, and it has been recently introduced into Florence. For the weighty objections to the dry closet system and to complete water sewage as carried out in London we must refer our readers to the work itself.

We regret that space does not permit us to enter upon a more detailed summary of the contents of this report, and we heartily commend it to the attention of members of the Legislature, magistrates, land-owners, as well as of the medical and chemical professions.

CORRESPONDENCE.

MANUFACTURE OF ARCHIL AND CUDBEAR.

To the Editor of the Chemical News.

Sir,—I am a working man. I have looked in a great many works on chemistry for information on the manufacture of archil and cudbear, but in all the works out there is no real practical information on the subject. I will write this short sketch as well as I can for your information, so that, if ever you write a work on the subject, you can inform your readers of the real practical part of the manufacture, as well as the theoretical and chemical changes. You would confer a great boon on the masters in the trade, as well as the workmen, if ever you brought a work out on the subject. I believe one great obstacle in the way of authors getting information on the practical part is because the manufacturers keep it as secret as possible. As an instance, at the place where I work they will employ no one that has worked in any chemical trade; and when they do employ anyone, there is a deal of cross-questioning about where they have worked, and whether they can read and write, and if they can it is ten to one whether they employ him, because they want the men as ignorant as possible—they want them to do the bidding, but not to make any mistakes, and not to inquire into things. Then they will let any of us stop while we are old men, which is very common in chemical works. That is the main cause of so much secrecy.

Archil Liquor.—To make liquid, put 300 lbs. of Zanzibar orchella-weed into a cistern, about 120 gallons of ammonia at 3° strong on the top of it; steep day and a night; run it out of the cistern into pans heated with steam pipes underneath, the size of which is 6 yards by 4, 1 foot deep, with a lid on the top. Take the lid off once a day, about five minutes agitate it a little, and then it will be ready in about six weeks for storing up or dyeing with. Worth about 3d. per lb.

Paste Archil.—To make paste archil, the weed is ground a little; it is worked in pans heated with steam-pipes underneath (size, about 4½ feet long, 2½ feet wide, 2 feet deep), with an iron lid to fit on to keep the ammonia gas in. In these pans we put 50 lbs. of weed, 100 of ammonia 8° strong. It is turned over with a shovel twice a day (morning and night), and it will be ready for coming off in about eight days; then it is mixed with 20 lbs. of sulphuric acid and 200 of common salt. That is for four of these pans; contents of all four put into a cistern, the acid, salt, and water mixed together. Worth about 2½d. per pound.

Cudbear.—To make cudbear is just the same as paste. Instead of mixing with salt, acid, and water, it is dried on an iron plate about 10 yards square, with steam heating it underneath. When it is dried, it is ground to a powder; then it is cudbear of commerce. Worth about 8d. per lb.

Blue Archil.—To make blue archil, put 100 lbs. of weed, 300 of ammonia 6° strong; work cold; turn over twice a week. It will be ready in about ten weeks. That is blue archil of commerce.—I am, &c.,

A Leeds Workman.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 4, July 27, 1874.

Action of Rays of Different Refrangibility upon the Iodide and Bromide of Silver. Influence of Colouring Matters.—E. Becquerel.—It is known that the physical condition of bodies susceptible to the action of light, as well as the presence of matters affecting the chemical effects produced, may not only augment their sensitiveness, but may even modify the extent of the part of the luminous spectrum in which they are acted on. If iodide of silver is prepared as in Daguerre's process, and then exposed to the solar spectrum without having been previously acted on by light, it is only sensitive from the blue to the extremity of the ultra-violet. But if iodide of silver has been previously insolated for a short time before the action of the spectrum, it is not only sensitive within the limits above mentioned, but also between the red and the blue. If iodide of silver is obtained by double decomposition, and fixed upon paper, or incorporated with collodion or gelatine, the effects may vary according to circumstances. If precipitated in an isolated pure state it is almost inactive. If fixed upon paper, and in presence of an excess of nitrate of silver, it becomes very sensitive, presenting two maximum points of action, one in the yellow, and the other in the blue-violet. The bromide and chloride of silver behave in a similar manner. If iodide of silver is incorporated with collodion, so as to form the sensitive surfaces commonly used in photography, and if, either with or without previous insolation, it is exposed while moist to the action of the solar spectrum for a short time, and the image obtained is developed by means of protosulphate of iron, or pyrogallic acid, we observe in general merely an action extending from the ultra-violet to between F and G, with a maximum of action between G and H, but nearer G. Chloride of silver behaves the same. The bromide gives in these conditions a longer spectrum, extending to the green. With dry collodion the effects are the same as with paper in the conditions indicated above. Vogel has observed that if bromised or iodised collodion is mixed with various colouring matters, the extent of the sensitive zone is changed, and the surface may become immediately affected by the red, yellow, or green rays, according to the nature of the substance. Thus the surface becomes sensitive to rays which, in the absence of these colouring matters, would be inert. Coralline and aniline-green give very marked results. With coralline the chemical spectrum extends to the orange, with a maximum point in the green between D and E. With chlorophyll in very small proportion, the sensitive region extends from the ultra-violet to beyond E in the green.

Report on Methods for Protecting Vines from the Phylloxera.—MM. Milne-Edwards, Duchartre, &c.

Researches on Explosive Bodies.—MM. Noble and F. A. Abel.—An account of these researches has already appeared in English.

Amount of Water Consumed by Wheat during its Growth.—M. Marié-Davy.—An account of experiments showing the quantity of water required by wheat planted in different soils, and treated with different manures.

Production, in the same Medium and at the same Temperature, of the Octahedral and Prismatic Varieties of Sulphur.—M. D. Gernez.—It is generally assumed that the polymorphic varieties of bodies can only take their origin under different circumstances of medium or of temperature. The author has succeeded in producing at will, in the same liquid and in the same temperature, either the one or the other of the two forms of sulphur. He places in a tube closed at one end either variety of sulphur, *e.g.*, octahedral crystals, and dissolves them in toluen or benzin at a temperature considerably below 80°, and thus prepares a supersaturated solution. When this is cooled down to 15° without crystallising, he introduces the end of a stiff wire carrying an octahedral crystal. Immediately crystals, all octahedral, form, and slowly increase. If a prismatic crystal is introduced, prisms are formed in the same manner.

Action of Ether on Binoxide of Copper.—Aug. Gueront.—When anhydrous ether is heated in a closed vessel to about 280° with binoxide of copper obtained by precipitation, and dried *in vacuo* over sulphuric acid, the oxide becomes a yellow mass. On treatment with dilute hydrochloric acid this mass is resolved into metallic copper, and a small quantity of hydrated protoxide of copper. The liquid products are, besides ether, aldehyd and acetic acid. If the black oxide of copper still contains moisture, the result is anhydrous protoxide, the colour of which is slightly modified, and a small quantity of metallic copper. Acetic acid is produced in this case in a smaller quantity. Black oxide of copper, prepared in the dry way, is not reduced by ether, whether water be present or absent.

On Isoterebenthen.—M. J. Ribau.—This paper is not adapted for abstraction.

Splitting-Up of the Fibrin of Blood, and the Production of a Substance Analogous to Ordinary Albumen.—A. Gautier.—A solution of fibrin in aqueous chloride of sodium is freed from salt by dialysis, and rapidly concentrated by distillation in a vacuum at a temperature of 45°. A neutral solution is thus obtained, possessing most of the properties of ordinary albumen.

Antiseptic Property of Heavy Coal-Oil.—M. L. Dusart.—An account of experiments on the action of "heavy oils" upon putrescent matter.

New Process for the Manufacture of Stuccos, or Cements known as Aluminous.—M. Ed. Landrin.—This paper does not admit of useful abstraction.

Decomposition of Albumenoid Matters in a Vacuum.—MM. Gréhant and E. Modrizejewski.—Analyses of the gases given off by 100 c.c. of dog's blood, previously freed from fibrin, and kept for four days in a vacuum at the temperature of 45° to 52°.

Phosphates of Lime of Ciply, in Belgium.—M. Nivoit.—The deposit lies near Mons, in the upper part of the chalk. The nodules have the following composition:—

Water	25·55
Organic matter	
Carbonic acid	
Sand and clay	1·30
Phosphoric acid	20·35
Sulphuric acid	0·12
Chlorine	0·25
Fluorine	0·18
Lime	51·60
Oxide of iron	0·90
	100·13

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 11, July 13, 1874.

Identity of Phenyl-Carbamidol and Diphenyl-Urea.—W. Lossen.—The author shows that the products arising on the formation and decomposition of both bodies are identical, and that both may be expressed by the same formula.

Tetra-Phenyl-Guanidin and Diphenyl-Cyanamid.—W. Weith.—This paper contains an account of the action of chloride of cyanogen upon diphenylamin; of tetra-phenyl-guanidin and its salts; its behaviour with hydrate of potassa, and with aqueous hydrochloric acid; the constitution of diphenyl-cyanamid; its behaviour with potassa, with aniline, and diphenylamin; and the formation of polymeric diphenyl-cyanamid.

Contributions to the Establishment of the "Position Formulæ" of the Allyl Compounds, and of Acrylic Acid.—E. Linnemann.—From this lengthy treatise we extract the following propositions:—Acrylic acid, even at an average atmospheric temperature, takes up nascent hydrogen from acid solutions, and is thus converted into propionic acid by all known ordinary hydrogenising agents. [Caspary and Tollens maintain that acrylic acid is not convertible into propionic acid by zinc and sulphuric acid.] Allyl-alcohol, if treated at elevated temperatures with zinc and sulphuric acid, takes up hydrogen, and becomes normal propylic alcohol. [This, as the author points out, is again an opposite result to that reached by Tollens.] Allylic alcohol takes up nascent hydrogen from an alkaline solution only with great difficulty.

New Dinitro-Benzol.—A. Rinne and Th. Zincke.—This compound contains 42·85 per cent of carbon, and 2·38 per cent of hydrogen. Its formula is $C_6H_4(NO_2)_2$.

Behaviour of Alcoholic Yeast in Media free from Oxygen Gas.—Moritz Traube.—The results of the experiments described are—(1) Yeast germs do not develope themselves without free oxygen, even in media favourable to their growth, such as grape-juice. (2) Developed yeast, on the other hand, as Pasteur correctly maintains, can increase in suitable media, in the absence of every trace of oxygen. (3) Pasteur's statement that yeast, if air is excluded, can obtain the oxygen necessary to its growth from sugar is incorrect, for the increase ceases whilst the greater part of the sugar is still undecomposed. The accompanying albumenoid bodies are used for its grow by yeast secluded from air. (4) In a solution of pure sugar yeast occasions alcoholic fermentation in the absence of every trace of oxygen, and without increasing. The assertion of Pasteur that the fermentation of sugar is connected with the process of organisation of the yeast is incorrect. (5) Whilst grapes, on exclusion of air, produce alcohol from their sugar, even if much bruised, this property is no longer possessed by the expressed juice. (6) It does not hence necessarily follow that alcoholic fermentation is a vital process, depending on the activity of the living cells.

Constitution of Chrysin and Tecto-Chrysin.—J. Piccard.—The author describes the reactions of the above-named bodies, and gives an account of anhydrous phloro-glucinic acid.

Communications from the Laboratory of Würzburg University.—J. Wislicenus.—Further researches on diaceto-succinester, aceto-succinester, aceto-malonester, and allyl-acetester.

Further Communications on the Compounds of Iodine and Thallium.—Th. Knösel.—The protiodide of thallium, TlI, can be obtained in a red, a green, or a yellow state. The yellow modification passes rapidly into the green on exposure to direct sunlight.

Action of Ethyl-Oxalic Chloride upon Sulph-urea.—B. Peitzsch.—Hydrochloric acid is given off along with carbonic oxide, and a tough orange mass remains, which, after re-crystallisation from alcohol and treatment with animal charcoal, yielded colourless rhombic prisms, $C_4O_2SN_2H_8$.

Lecture Experiment on Osmose.—Arnold Heintz.—This paper requires the accompanying illustration.

Researches on the Volume-Constitution of Solid Bodies.—H. Schröder.—Not adapted for abstraction.

New Sulphuretted Derivative of Hydrocyanic Acid.—O. Wallach.—The new substance, chrysean, consists of:—

Carbon	30·20
Hydrogen	3·14
Nitrogen	26·41
Sulphur	40·24
	99·99

corresponding to the formula $C_4H_5N_3S_2$. Chrysean is a solid body, resembling Mosaic gold in appearance, sparingly soluble in cold water, more readily in hot water, alcohol, ether, acids, and alkalies, from which it crystallises unchanged. A chip of firwood dipped in the sulphuric or hydrochloric solution is coloured red.

Resorcin from Dinitro-Benzol.—C. Wurster and E. Nölting.—The authors have obtained resorcin from brom-nitro-benzol.

Test for Narcein.—A. Vogel.—If narcein is placed in a watch-glass, and covered with chlorine water, and if a few drops of ammonia are added with constant stirring, a deep blood-red colour appears, which does not disappear either on the addition of an excess of ammonia or on constant stirring.

The Three Isomeric Compounds, C_2H_4BrI.—H. Lagermarck.—Not suitable for abstraction.

Researches on the Substitution of the Nitro Fatty Bodies.—J. Tschermak.—Not suitable for abstraction.

Communications from the Laboratory of the London Institution.—H. E. Armstrong.—Notices on the behaviour of the nitrophenol which melts at 45° with bromine and chlorine; on the behaviour of the same nitrophenol with sulphuric acid; an the position of the sulpho group in phenol-para-sulphonic acid; and on the decomposition of dichlor-nitrophenol by heat.

A Fifth Oxy-Toluylic Acid.—F. Fittica.—This fifth acid has the same composition as the former four. It is obtained from mono-nitro-toluylic acid, melting at 190°. It does not become violet with chloride of iron.

Action of Chloroform upon Sodium Acetic Ether.—A. Oppenheim and S. Pfaff.—Not suitable for abstraction.

The Phenomena of Neutralisation, and the Basicity of Arsenious Acid in an Aqueous Solution.—Julius Thomsen.—Arsenious acid in aqueous solution is a feeble bibasic acid, and its salts, with a large amount of base, must be regarded as basic salts.

Diphenylated Guanidin.—W. Weith and B. Schrœder.

Diphenyl Guanidin.—A. W. Hofmann.—Both these interesting papers are unsuitable for abstraction.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 11, June 5, 1874.

Purification of Cerebrine.—Edme Bourgoin.—The cerebrine is extracted in the ordinary manner by means of alcohol and ether. In this state it contains a small quantity of phosphorus. To purify it it is treated with a sufficient quantity of alcohol at 90°, raising the temperature gradually and slowly. Cerebrine dissolves below the boiling-point, whilst a viscid phosphuretted matter is left adhering to the bottom of the vessel. The clear liquor is decanted, when the cerebrine is deposited on cooling. As thus obtained it is free from phosphorus. With Gobley, the author does not consider Liebreich's protagon a definite body, but a mixture.

On Cohesion.—M. West.—A physical paper.

Manganic Acid.—T. L. Phipson.—With reference to a paper by M. Terreil, the author points out that in 1860 he stated reasons for regarding the permanganate of potash as a bimanganate analogous to bichromate and bisulphate, and that manganese forms only one acid.

Thermic Researches on Hydrogen.—P. A. Favre.—The author maintains that in the hydride of palladium the hydrogen is in an active state, as are certain elements in explosive bodies.

Reclamation Respecting a Paper by M. J. Thomsen.—P. A. Favre.—A controversial note as to priority.

Influence of Nitrogen in Textile Fibres on the Direct Fixation of the Aniline Colours.—E. Jacquemin. The author finds that cellulose, on being converted into gun-cotton (nitro-cellulose), becomes capable of taking magenta, aniline blue, &c., without the intervention of a mordant, just like silk or wool. He does not, however, consider that this fact can have any practical value in the tinctorial arts. It must not be supposed that the presence of nitrogen in an organic body necessarily implies the power of combining with artificial colours. Thus oxamide refuses to take up magenta even at a temperature of 80° C.

Correspondence from St. Petersburg; May, 1, Old Style.—W. Louguinine.—Transactions of the Russian Chemical Society at its session, Feb. 7, 1874.

Determination of Chlorine in Animal and Vegetable Bodies.—Behaghel von Adlersknon.—To prevent a loss of chlorine in the incineration of organic matter either baryta or carbonate of soda is added. The amount found is always smaller in the former case than in the latter. The author has sought to find whether these additions really prevent a loss of chlorine. His experiments prove that all organic bodies determine by their incineration the decomposition of a certain amount of alkaline chloride. All the alkali is found in the ash, but not all the chlorine. The loss of chlorine is larger the smaller the proportion of alkaline salt to the organic matter. The addition of baryta, or of carbonate soda, lessens the loss of chlorine, which may even become *nil* if the addition is made extensive enough. Baryta requires to be added in larger amount than carbonate of soda. A second series of experiments proved that presence of phosphates is the cause why the chlorine is found too low. The author proposes the following mode of incineration:—Add hydrate of baryta to the extent of at least 10 per cent of the organic matter, ignite, dissolve the ash, which must be quite free from carbon, in cold dilute nitric acid, and determine the chlorine and alkalies in the solution in the ordinary manner.

Turkey Red Dyeing with Artificial Alizarin.—In the use of madder, the oil-bath is followed by treatment with tannin; but when artificial alizarin is employed the oiled yarns are at once mordanted with alumina. The best alum mordant is prepared by mixing the solutions of 100 kilos. of crystallised alum and 15 kilos. soda crystals. The clear liquid should mark 4° B. The cotton is left an entire day in this solution. It is then washed carefully, wrung, and passed into a bath of alizarin and tannin (500 grms. tannin to 50 kilos. of yarn, alizarin 7·5 to 5 kilos.). When the water of the bath is not calcareous, chalk may be added to the extent of 100 grms. The bath should be cold at first, and is heated very gradually, a boiling temperature being finally kept up for an hour. The yarn is then, without clearing, treated with soap and annatto. Salts of tin are only applied for rose shades.

Deep Maroon on Silks.—10 kilos. of silk are worked to saturation in a bath of 10 kilos. of catechu, and finally boiled for five minutes. It is immediately entered in a fixing-bath of 200 grms. bichromate of potash at 30°. It is well rinsed, and then dyed in a bath of 1 kilo. fustic, 200 grms. orchil, 100 grms. indigo-carmine, 500 grms. alum, and 100 grms. sulphuric acid. These proportions are varied according to the shade required.

Aniline Grey for Calico-Printing.—Ed. Lauber.—Dissolve 625 grms. chlorate of potash in 3½ litres of boiling water, and add when cold—

Gum-water at 1 kilo. ..	6·5 litres.	
Sal-ammoniac	312·5 grms.	
Chromo-potassic tartrate	1500 ,,	at 30° B.
Aniline	200 ,,	
Tartaric acid	1160 ,,	

To prepare the chromo-potassic tartrate, 960 grms. of bichromate of potassa are dissolved in 3 litres of hot water. When cooled down to 44° C. 1440 grms. of tartaric acid in powder are gradually added, avoiding a rise of temperature, which might modify the product. The preliminary reduction of the bichromate might be effected by an agent cheaper than tartaric acid, such as sugar. After printing the pieces are aged at 32° C. for forty-eight hours, and then washed for one hour. This grey is pure, and gives good grounds. It can be submitted to all the operations required for madder reds, except the passage through solution of tin crystals.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent Examinations:—*First B.Sc. Examination* (*Pass List*).—First Division—F. W. Aveling, M.A., University and New Colleges; J. Boynes, St. John's College, Cambridge; J. W. Buck, private study; J. Bush, private tuition and study; T. Capper, private study; S. H. Carrington, Owens College; F. A. Cooper, University College; J. K. Crow, Owens College; G. Gates, B.A., University College and private study; R. Gill, Royal Institution School, Liverpool; F. Gotch, B.A., University College; J. S. Jellie, private study; T. Lattimer, Owens College; W. Lee, Owens College; D. McAllister, St. John's College, Cambridge; A. Matthews, Sidney Sussex College, Cambridge; J. M. H. Munro, College of Science, Dublin; W. Saise, Royal School of Mines; A. J. Smith, Owens College; G. Smith, Royal School of Mines; J. H. Ward, Crescent School, Margate. Second Division—J. K. Bond, B.A., private study; R. Capron, B.A., private study; J. Fewings, B.A., Queen Elizabeth's Hospital and private study; E. Jackson, B.A., Owens College Medical School; J. I. Paddle, B.A., Royal College, Mauritius; J. R. Rendell, Owens College; H. D. Waugh, B.A., University College; A. H. S. White, B.A., University College. *Examinations for Honours* (*First B.Sc. and Preliminary M.B. conjointly*).—*Chemistry.*—First Class—J. M. H. Munro, First B.Sc. and Prel. Sci. (Exhibition), College of Science, Dublin. Second Class—J. C. Uhthoff, Prel. Sci., Guy's Hospital; A. T. Wilkinson, Prel. Sci., Owens College Medical School; A. J. Smith, First B.Sc., Owens College. Third Class—T. Capper, First B.Sc., private study; A. Tilly, Prel. Sci., St. Mary's Hospital; G. Smith, First B.Sc. and Prel. Sci., Royal School of Mines; J. K. Crow, First B.Sc. and Prel. Sci., Owens College; R. Gill, First B.Sc. and Prel. Sci., Royal Institution School, Liverpool; F. H. Berry, Prel. Sci., Guy's Hospital; J. Wigglesworth, Prel. Sci., Liverpool School of Medicine; A. E. Maylard, Prel. Sci., Guy's Hospital; A. R. W. Sedgefield, Prel. Sci., King's College; R. S. Wainewright, Prel. Sci., Guy's Hospital. *Experimental Physics.*—Second Class—A. Tilly, Prel. Sci., St. Mary's Hospital. Third Class—R. Gill, First B.Sc. and Prel. Sci., Royal Institution School, Liverpool.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of asbestos and in its application to various useful purposes in the arts and manufactures. Thaddeus Hyatt, Gloucester Gardens, Hyde Park, Middlesex. December 24, 1873.—No. 4241. This invention comprises the manufacture of asbestos chenille from short fibre asbestos for packing for steam engines. Attaching asbestos to any suitable backing by wire or other stitching or by cement like pile carpets, or like bristles in a brush-back, or forming the backing of cement or rubber solution making bearings and packing of asbestos by compressing it in moulds or holders in combination or not with anti-friction metal or alloy. Making a combination or admixture of molten metal and asbestos for the same purpose. Making packings of asbestos enclosed in a tubular open casing of open wire-work or fibrous material braided, woven, or otherwise applied. Introducing a core of cotton, hemp, or cheap fibre into the centre of a rope packing of asbestos to economise the asbestos. The enclosing ropes, cakes, or blocks of asbestos in metal fail to render it merchantable and easy of handling. Making asbestos wadding or "batting" of teazed or corded asbestos coated with any suitable glaze or skin. Combining asbestos with earthy matter or with any animal or vegetable fibre dissolved or not in "copperised ammonia" and applied in a plastic state to the manufacture of various articles. Making artificial asbestos stone, also burnt bricks and tiles.

Improvements in extracting and utilising waste fatty and colouring matters contained in the washings of print- and dye-works. George Joseph Alfred Wuth, Accrington, Lancaster. (A communication from Richard Albert Forster, Augsburg, Bavaria). December 31, 1873.—No. 4286. At print- and dye-works, the printed or dyed goods are usually washed with soap and water to free them from any excess of colouring matter and other substances which are injurious to the brightness of the colours. The liquors used for that purpose, which now generally are allowed to run away, though they contain a large quantity of valuable colouring and fatty matters, can be made useful, and the improvements described in this Specification have the purpose to regain and extract the fatty and colouring matters out of these liquors.

A new or improved manufacture of nutritive hygienic compounds or preparations. Bristow Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, chemist, Paris). December 31, 1873.—No. 4290. The object of the present invention is to produce various preparations intended to serve as a complement to alimentation, by furnishing to the animal economy, under an appropriate form, perfectly definite as to quantity and quality, certain bodies or matters which are not always found in suitable proportions in food; in addition to which these bodies act as powerful means of regulating the performance of the functions of the human body. First preparation—Water, 300 grms. or parts by weight; lacto-phosphate of lime, 15; fluoride of potassium, 0·75; ammoniacal citrate of iron, 6; citrate of manganese, 1; citrate of potash, 1. Second preparation—Lacto-phosphate of lime, 15 grms. or parts by weight; fluoride of potassium, 0·75; water, 300; sugar, *quantum sufficit.* Third preparation—Containing fluoride of potassium (or of soda or ammonia) of from 0·25 to 20 grms. Fourth preparation—Pastilles or bonbons to be used containing powdered bone in its natural state without having undergone any manipulation other than the most forcible mechanical division in order to obtain an impalpable powder.

Improvements in the method of and apparatus for separating free sulphur from substances with which it is mixed. Samuel Henry Johnson, manufacturing chemist, Lea Bank Works, Stratford, Essex. January 2, 1874.—No. 19. This Provisional Specification describes certain improvements in the method of and apparatus used for separating free sulphur, by means of certain chemical agents, from substances with which it is mixed. Also modifications and improvements in the necessary apparatus therefor.

Improvements in making sesquicarbonate of ammonia. Gavin Chapman, manufacturing chemist, Glasgow, Lanark, N.B. January 3, 1874.—No. 38. This invention consists principally in vapourising urine, gas liquor, or other ammoniacal liquor; removing some of the liquor when the carbonic acid becomes deficient; distilling ammonia from the removed liquor, carbonating it, and mixing it with the raw liquor.

Improvements in the mode of preventing the incrustation of boilers, and in the apparatus connected therewith. David Clovis Knab, Saint Denis, France. January 5, 1874.—No. 53. A solution of carbonate of lime is precipitated with a proportionate quantity of lime-white, and the water for defecation is led by a conduit to a continuous filtering apparatus, consisting of two, three, four, or more frames of iron, zinc, or wood, similar in construction, and boxing one within the other, and either square, round, or other suitable form; within these frames a felt or other filtering substance is stretched, and when the matter to be filtered is very tenuous, a layer or layers of carded cotton having the filtering surface between two metal sheets is employed. The water arriving at the first filter is clarified after passing through the second and third ones. When the water is very impure the first filter becomes choked; it is consequently removed by levers, or otherwise, and cleansed in a water-bath. The whole column of filters is raised mechanically, and under the last a clean filter is placed; the second becomes the first, the others following in rotation. The more frequently the first filter is removed, the quicker the filtering is performed. The water contained in the last filter still holds sulphate of lime in solution unprecipitated by the lime water, nevertheless the water is purified to the extent of two-thirds. To prevent this sulphate from injuring the heated sides of the generators, a proportionate quantity of ulmic acid is added to the water, which prevents the agglomeration of the salts by transforming them into mire.

An improved process for preparing hydrate of magnesia. William Edward Newton, civil engineer, Chancery Lane, Middlesex. (A communication from C. H. Phillips, New York, U.S.A.) January 6, 1874.—No. 72. This invention consists, first, in preparing a pure superhydrate of magnesia, by subjecting a soluble salt of magnesia to the action of a caustic alkali; and, secondly, in preparing a medical compound, consisting of a superhydrate of magnesia mixed with water and termed "milk of magnesia."

An improved manure. John Frazer Corkran, Cannon Street, London. (A communication from Andrew Archbald, Florence, Italy.) January 7, 1874.—No. 87. This manure is composed of pine wood, sawdust, and animal blood, mixed and dried as soon after the animal is slaughtered as possible.

TO CORRESPONDENTS.

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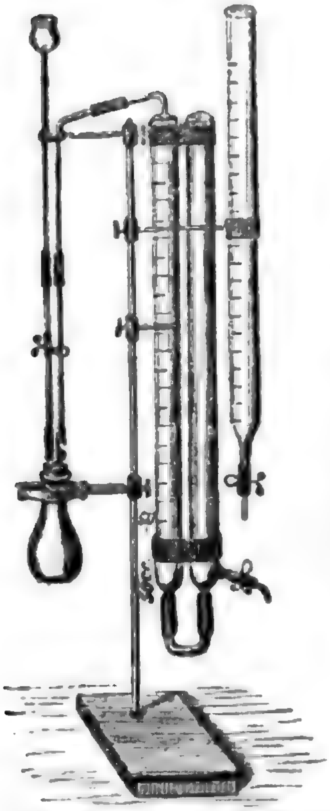

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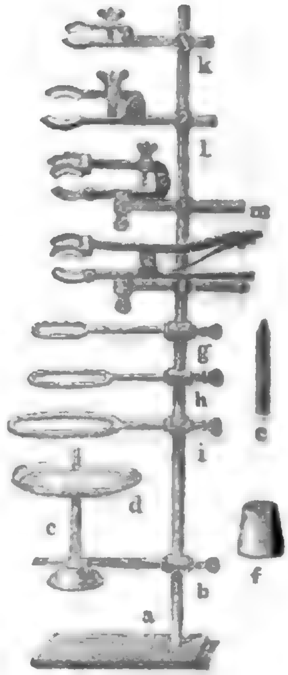

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THE CHEMICAL NEWS.

Vol. XXX. No. 774.

DETERMINATION OF HIGH TEMPERATURES BY MEANS OF THE REFRANGIBILITY OF THE LIGHT EVOLVED BY FLUID OR SOLID SUBSTANCES.

By JAMES DEWAR.

It is well known that as the temperature of a solid is gradually increased, the refrangibility of the emitted light increases likewise; and as the result we find red light emitted first, and gradually the other coloured rays appear until we reach the ultra-violet rays. This correlation between refrangibilty and temperature was first experimentally proved by Draper;* and it would be a result of great importance to determine accurately the law of growth of refrangibility with temperature. If this could be achieved, a very easily applied and accurate pyrometer could be made of the ordinary spectroscope.

There are various difficulties, however, that beset this investigation at the outset. First of all, the rapid growth of the new rays confines the observations within narrow limits of temperature; secondly, the want of equal sensibility of the eye for rays of all wave-lengths; and, thirdly, the interference of diffused light preventing exact definition. It thus appears to be futile to attempt or even expect accurate observations in these circumstances through registration by the human eye, although, on first considering the subject, it appears to be a very easy matter. Finding no means of overcoming these difficulties, unless by the use of complicated apparatus, involving the use of rock-crystal prisms and lenses or fine gratings and the employment of photographic registration, requiring time and thought previous to execution, a series of observations have been made in the meantime on the increase of radiation with temperature, an inquiry of vital importance with regard to this subject.

Becquerel, in his treatise on Light called "La Lumière," has detailed a great number of observations on the growth of luminous intensity with increasing temperature. From these experiments he infers that "the differences between the logarithms of the luminous intensities are proportional to the differences of temperature," proving that an exponential function of the form

$$I=a(e^{b(T-\theta)}-1),$$

where I is the luminous intensity, T the temperature of the body, θ the temperature at which the special ray begins to be evolved, a and b constants, and e the base of the logarithms adopted. The values of a and b, as deduced from the experiment, for the red ray are respectively 0·00743 and 0·005014. The above formula gives equally the growth of total luminous intensity if we take θ as 500° C., that point at which the light-rays begin to be evolved, and a and b as now having the respective values of 0·12053 and 0·00764. From the last formula Becquerel gives the following values of the total luminous intensity of a solid substance at different temperatures, stating it is probable the above law does not hold above 1200° C.:—

Temperature.	Total luminous intensity.
916 (fusion of Ag)	1
1000	4·37
1037 (fusion of Au)	8·38
1100	25·41
1157 (fusion of Cu)	69·26
1200	146·92
1500	28900
2000	191,000,000

From the similarity of these formulæ with Dulong and Petit's law of heat-radiation, Becquerel regards them as being confirmed by analogy. The determinations of the temperatures in his experiments were all deduced from the intensity of the thermo-electric current of a platinum-palladium junction, and the luminous intensities were determined by means of a photometer based on double refraction.

The observations made in connection with this Report on the increase of total luminous intensity have been conducted similarly to those detailed by Draper in the *Philosophical Magazine* for 1847. The apparatus has been modified so as to be more conveniently employed, and the experiments made were found, on being tabulated, to be very well expressed by the following empirical formula:—

$$990+n46=n^2I,$$

where I is the luminous intensity, and $990+n46^\circ$ is equa-to the total temperature—that is to say, above the temperal of 1036° C., by which time all the luminous rays may be considered present; the intensity is a parabolic function of the temperature. The curve of increase is therefore a very acute parabola.

As the observations on increase of luminosity above 1000° C. can only be carried on for a range of 500° C. with the expansion of platinum, it was very essential that some comparison between the results of the empirical law given above and actual observation should be made at higher temperatures. For this purpose, a series of observations were made as to the relative light-intensity of lime heated to a temperature of 2000° C. in the oxyhydrogen flame, and the same substance at the boiling-point of zinc, temperature 1040° C. The following plan was adopted in making observations:—A square pencil of lime, four or five millimetres on the side, and of a length of 50 millims., was supported horizontally, and the inner cone of a powerful oxyhydrogen flame was made to play on a smooth cross section of the pencil. The light emitted from this perpendicular surface had to pass through a small circular aperture into an adjoining dark chamber for the purpose of comparison with the light emitted from an equal surface of lime, the temperature of which was near the boiling-point of zinc. In order to get a temperature maintained near 1000° C., I have adopted the following method:—A piece of platinum of an equal surface with that of the radiating lime, and of a thickness of 2 or 3 millims., was supported by means of a platinum wire in the flame of a good Bunsen burner, the position in the flame having been found by experiment to maintain the mass at near the temperature required. This latter fact was ascertained by finding the amount of heat, the platinum emitted when thrown into a calorimeter containing a known quantity of water. As the amount of heat emitted was very small, special precautions had to be taken in guarding the calorimeter and in getting the mass of platinum transferred. The calorimeter, containing about 100 grammes of water, was floated in a cistern (having been previously placed in the middle of a tin cylinder, leaving an annular space between), and so loaded that the water in the calorimeter was sunk to the level of the water in the cistern. The Bunsen burner was placed in a tin vessel loaded with shot, so as to give a flame the upper half of which was above the level of the water in the cistern. By this means constancy of temperature was maintained, and the results agreed closely together. It is easy to be convinced that a mass of platinum like that employed, radiating freely, is rarely heated above a temperature of 1100° or 1200° C. Comparisons were made between platinum in the Bunsen burner and lime in the oxyhydrogen flame, and also between lime in both.

The photometer employed for comparing the lights was on the principle of that recommended by Bunsen. A wooden box, about 8 inches long, 4 inches broad, 3 inches deep, containing several diaphragms with circular apertures, thoroughly blackened in the interior, and having the aperture of the middle diaphragm covered with a piece of

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* *Phil. Mag.*, 1847.

Swedish filter-paper, marked with one or two circular spots of paraffin, was employed to exclude extraneous light and to obtain good definition. By this means it is possible to obliterate completely the spot of paraffin, and thus gain greater confidence in the results.

From the mean of a great number of experiments made in this way, the luminous intensity at about 2000° C. is from 500 to 550 times that at 1040° C. The calculated amount given by the above formula for the exact temperature of 2000° C. is 484 times that at the lower temperature. According to the formula of Becquerel, it would be about 24,000,000 times that at the lower temperature. This empirical law, therefore, gives with considerable approximation the luminous intensity up to a temperature of 2000° C.

Total Radiation.—If the law of Dulong and Petit for the velocity of cooling was true for temperatures above the range of the actual observations made in support of the law, the amount of heat radiated per unit of time would be found by multiplying the velocity of cooling at the temperature considered into the specific heat at that temperature and into the weight of the substance. From this may also be calculated the amount radiated per unit of surface. In fact, for the same substance the relative quantities of heat evolved at two different temperatures would be to each other as the velocities of cooling if the specific heat and the emissive power remained constant. This would give an extraordinary rapid rate to the growth of total radiation. For instance, taking the temperatures of 2000° C. and 700° C., we find, according to Dulong and Petit's law,

$$\frac{Q_1}{Q_2} = \frac{a^{2000}}{a^{700}} = a^{1300} = 21{,}545,$$

where a is the constant 1·0077.

Thus a substance radiates at a temperature of 2000° C. 21,000 times as much heat per unit of time as it does at a temperature of 700° C.

In order to compare the total radiation as given from the law of Dulong and Petit with that of actual experiment, a series of observations were made, and the total heat evolved registered by the use of Pouillet's pyrheliometer. For this purpose, a spherical ball of lime, 8 millims. in diameter, was formed by carefully filing and polishing on the end of a narrow pencil of the same substance. This little knob of lime was then gradually heated, carefully turning it round, up to incipient fusion in the oxyhydrogen flame, so as to allow contraction to take place. With care in this way, it is possible to get a very uniform sphere having a surface of about one square centimetre. The pyrheliometer was filled with bisulphide of carbon, for the purpose of registering minute alterations of temperature. The experiments were made at two distinct temperatures, viz. at a low visible red heat, and at the maximum temperature of the oxyhydrogen flame. The mean of these experiments has given, for radiation per square centimetre per minute at about 700° C., from 20 to 25 gramme-units per minute, and at 2000° C. maximum temperature from 2000 to 2500 gramme units—the ratio of the amounts being as 1 to 100, very different from the calculated result. The law of Dulong and Petit, therefore, gives a far too rapid increase for the total radiation; and if we assume the law to be true in order to define temperature, the results arrived at are always too low.

If the total amount of radiation at different temperatures is tabulated, using a thermo-electric pile and an apparatus similar to the one employed for light-intensities, it is found that the curve of increase may be very accurately represented by a parabolic curve. The empirical formula of this curve is

$$580° + n3 \times 46° = n^2 R,$$

where R is the total radiation at 668° C., and—

$$580° \text{ C.} + n3 \times 46° \text{ C.}$$

is equal to the temperature of the substance. If we calculate the total radiation from the above formula at 2000° C. as compared with that at 668° C., it is in the ratio of 1 to 112. Regarding these comparisons, they appear fairly within the limits of experimental errors. We would anticipate that a similar law would hold alike for heat-rays and light-rays.

Assuming these laws to be approximately correct, it is interesting to find what hypothetical temperature in the case of a solid or fluid substance would correspond with the luminosity and total radiation from the sun.

From the experiments of Fizeau and Foucault,* the luminous intensity of the sun is found to be 146 times that of the lime-light. A temperature of 13,000° C. according to the formula given above, would give 144 times the luminous intensity at 2000° C.

From the observations of Pouillet, the total radiation from 1 square centimetre of the sun's surface in 1 minute was 85,000 units, and cannot well exceed 100,000 units. At a temperature of 11,000° C., according to the above formula for total radiation, the amount would be 50 times that at 2000° C. Now we have found above that a square centimetre of lime at 2000° C. emits 2000 gramme-units per minute, so that a temperature of 11,000° C. would be sufficient to evolve 100,000 gramme-units, as much heat as is produced by the sun. The recent observations of Soret (*Bibliotheque Universelle* 1872) prove that the total radiation of the sun is between 50 and 60 times that of lime heated to 2000° C. in the oxyhydrogen flame. The estimate of 100,000 gramme-units per minute from the sun is therefore not too great, seeing that it is just 50 times the amount actually emitted by observation at 2000° C.

Experiments with Electric Arc.—The experiments formerly detailed to the Association on the specific heat of carbon up to a temperature of 2000° C. naturally suggested the attempt to define by observation the temperature of the electric arc, by determining the amount of heat evolved when pieces of carbon, heated between the poles, are thrown into a calorimeter. When a fifty-celled Bunsen's battery is employed, it is found that 1 gramme of carbon evolves as a maximum 850 units of heat when cooled from the temperature it acquires between the poles of the battery. This quantity of heat only corresponds to a mean temperature of 2000° C. in the heated carbon when the great increase in the specific heat of carbon is taken into account. In the experiments made with the battery, no precaution was taken to prevent the cooling of the piece of carbon between the poles from radiation, and consequently the substance never attained a uniform temperature. This fact is easily proved on examining the appearance of the carbon after use, when the substance is only changed into graphite in a few points. That temperature at which carbon changes into graphite may, in experiments of this kind, be used at a fixed point.

The luminous intensity of the electric arc, according to Fizeau and Foucault, is from 34 to 56 times that of the lime-light when 46 cells are employed, of small or large surface. According to the empirical formula previously given, this would correspond to a temperature of from 7000° C. to 8500° C.

In the course of the experiments with the battery, several determinations of the total radiation were made by the pyrheliometer. The mean of the observations, which were remarkably constant, corresponds to a radiation of 7100 gramme-units per minute, being equivalent to a solution of 4·5 grammes of zinc per minute. A concave parabolic mirror 1 yard in diameter, exposed perpendicularly to the sun's rays in this country, concentrates as much radiant energy as a 50-cell Grove's battery of large surface.—*Report of the British Association for the Advancement of Science*, 1873.

Food Adulteration Act.—Mr. Robert S. G. Paton, Ph.D., F.C.S., has been appointed Analyst for the Borough of Stirling, N.B.

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* *Ann. de Chim. et de Phys.*, 1844.

ANALYSIS OF WATER TAKEN FROM THE "OLD CRESCENT WELL," HARROGATE, NOVEMBER 14th, 1873.

By THOMAS FAIRLEY,
Lecturer on Chemistry, Leeds School of Medicine, &c.; Consulting Chemist to the Yorkshire Agricultural Society; Public Analyst for Leeds.

TEMPERATURE of the water, 47° F.; of the air, 44° F.; sp. gr. of the water, 1·00188. It contains, in grains, per gallon:—

1.	Calcium sulphate	0·031	containing	Anhydrous sulphuric acid	0·020	Lime	0·014
	„ carbonate ..	5·606	„	Carbonic acid	2·464	„	3·142
	Magnesium carbonate ..	4·095	„	„ „	2·145	Magnesia ..	1·950
	Silica	1·128	„	Silicic acid	1·128	—	—
2.	Sodium sulphydrate ..	0·568	„	Sulphuretted hydrogen ..	0·345	Sodium	0·223
	„ carbonate.. ..	13·774	„	Carbonic acid	5·718	„	8·056
	„ sulphate	10·224	„	Sulphuric acid..	5·761	„	4·463
	„ chloride	88·167	„	Chlorine	53·503	„	34·664
	Potassium chloride ..	12·710	„	„	5·997	Potassium ..	6·713
	Calcium chloride	5·827	„	„	3·727	Calcium ..	2·100
	Magnesium chloride ..	6·862	„	„	5·128	Magnesium ..	1·734
	Ammonia	0·022	„	— —	—	Ammonia ..	0·022
	Organic matter	0·970	„	Organic matter, acids, &c.	0·970	—	—
	Total	149·687		Total acids, &c. ..	86·606	Total bases, &c.	63·081

The water contains traces of lithium, manganese, iron, barium, bromine, and iodine. The organic matter contains 0·006 of nitrogen; it consists partly of acids, some belonging to the fatty acid series, such as butyric, &c. The water contains the following gases, expelled by ebullition *in vacuo*:—

	Cubic inches per gallon.
Sulphuretted hydrogen ..	traces
Carbonic acid	6·85
Nitrogen	5·88
Carburetted hydrogen ..	traces
	12·73

As the well was inaccessible, the water had to be pumped up. It was taken after ten minutes' flow of water by pumping.

The substances bracketted together in (1) are those which are precipitated by boiling, while those in (2) remain in solution. In the absence of more definite knowledge as to how the acids and bases are arranged in combination, I have made use of the precipitations which happen on boiling as a basis of arrangement.* Of course, it is very probable that there are different arrangements at different temperatures. I have given the acids and bases separately to admit of more convenient comparison.

Analysis of the "Old Crescent Well" Water, expressed in parts per 1000.

Calcium sulphate	0·0005
„ carbonate	0·0801
Magnesium carbonate ..	0·0512
Silica	0·0161
Sodium sulphydrate	0·0081
„ carbonate	0·1968
„ sulphate	0·1460
„ chloride	1·2595
Potassium chloride	0·1815
Calcium chloride	0·0832
Magnesium chloride.. ..	0·0980
Ammonia	0·0003
Organic matter	0·0138†
Total	2·1351
Total by simple evaporation	2·1249
Chloride of lithium	trace
Sulphate of barium	„
Carbonates of iron and manganese	„

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* The dry solid residue was treated with cold water, and the filtrate and insoluble matter analysed separately.

† Containing 0·0008 of nitrogen.

ON THE
MODE OF PRODUCING AURIFEROUS ALLOYS BY WET PROCESSES.*

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

IN former papers read before this Society,† I showed that metallic sulphides generally reduced gold from both acid and alkaline solutions; that silver, as nitrate, was reduced by galena and sulphide of copper, but not by iron pyrites, while its ammoniated solutions were unaffected by any of the sulphides experimented with; and, from a consideration of these results, I suggested that most of our native deposits of noble metals have been formed by the agency of metallic sulphides, and not by that of organic matter, as has hitherto been generally supposed.

The question which naturally presented itself to me at the time, as to the capability of processes of this nature producing alloys of such metals (as found in Nature), was tacitly left over for consideration until the behaviour of these sulphides with metallic solutions should be more fully examined.

In pursuit of this question as to the possibility of obtaining mixed metallic deposits or alloys by the agency of metallic sulphides, I have from time to time, as opportunity offered, studied the behaviour of different sulphides when in contact with various salts of gold and silver, and the principal results thus obtained I now beg to state.

1. That solutions of chloride of silver in alkaline chlorides, rendered alkaline by addition of potash, soda, or lime, are readily decomposed by common iron pyrites.

2. That this effect is not produced if such solution of silver is either acid or neutral.

3. That when chloride of gold is added to an alkaline argentiferous solution of this nature, such mixed solution is capable of depositing the metals contained in it in the form of coherent alloys upon metallic sulphides generally when presented to them.

4. That these alloys can also be formed from such solutions by voltaic action.

As will be seen, these results show that, by allowing an alkaline solution of gold and silver contact with iron pyrites (a mineral of most common occurrence in our reefs), we obtain that mixed deposit or alloy we are seeking to produce.

The only condition which appears to me, from the results of numerous experiments, necessary in regard to such metallic solutions is that they should be not only alkaline, but alkaline from presence of a fixed alkali or alkaline earth, and it will be remembered, perhaps, in connection with this circumstance, that this alkaline condition is one which I have recently shown‡ to be that of our silicates generally, whether simple or compound, with the exception of silicate of alumina and other corresponding silicates of the sesquioxides, while quartz itself, whether free or in combination, is either quite neutral or of such very feeble acidic powers as regards intensity that, when united, even in very greatly disproportionate quantity, with alkalies or alkaline earth, the resulting compound gives an alkaline reaction.

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* Read before the Wellington Philosophical Society.

† See *Trans. N. Z. Inst.*, vol iii., Arts. xl. and xli.

‡ *Trans. N. Z. Inst.*, vol. iv., Art. lvi.

If such, then, are the conditions (alkalinity or neutrality) of our surface rocks generally, it is clear that the condition of the water permeating them at some distance from the surface would be alkaline, the intensity of which would be largely increased were the retaining rock subjected to those hydro-chemical influences popularly supposed to have operated for the deposition of their older vein matters and their metallic contents.

The fact that many mine-waters are acid does not affect the truth of the conclusion thus drawn as to the general alkaline condition of the waters charging our rocks, since this acidity is, as is well known, brought about by the contact of air with pyritous matters, metallic sulphates thus being formed, which communicate an acid reaction to water dissolving them. This is a mere surface affair as it were, and is besides in its manner of production entirely distinct from, if not antagonistic to, that by which gold has been deposited in the pyritous portions; for a slight examination of these shows that the gold present in them has been deposited there before they were oxidised by atmospheric agency.

Alkalinity being, then, certainly the general condition of our waters permeating rocks closed, or partially so, against the atmosphere, and this condition of liquids appearing essential for the production of alloys by humid methods, as shown here, it does seem highly probable that our native alloys of gold and silver have been deposited from *alkaline* solutions, and by such agents as I have suggested, viz., the metallic sulphides.

I will only add, in reference to the mode in which our deposits of native gold have been formed, that, while the number of substances capable of precipitating this metal from solution is many, the number of those at all likely to have been actually concerned in the production of these deposits is very small indeed. As far as at present appears, the substances capable of reducing gold, and likely to occur in the interior parts of our rocks, are ferrous sulphate of iron, organic matter, and metallic sulphides. These also reduce silver from certain of its solutions, but, as already noted, the difficulty is in finding a substance which will reduce these two metals simultaneously in coherent forms, and from such kinds of solutions as generally permeate our rocks. With this double duty to perform, and limited in this manner as regards nature of solvent, I cannot avoid thinking that but one of these reducing agents, the metallic sulphides, will be found equal to the occasion. The ferrous sulphate is thrown out at once from this service on account of its insolubility in such a menstruum, while organic matter appears to have a decided tendency to scatter the gold it reduces, nor have we, as far as I am aware, produced any true alloy of gold and silver by their use.

I would not intend to convey the idea that such a mixed deposition is impossible, but only that, from what we at present know of this subject, the production of such an alloy by these means appears a very difficult undertaking. However, this particular question has, I understand, been dealt with by Mr. Daintree, late Assistant Geologist to the Victorian Geological Survey,[*] so that the propriety or otherwise of retaining this theory of the origin of our auriferous deposits in their lodes by the inter-action of organic matter may be left in abeyance until Mr. Daintree publishes the results of his inquiry, as promised.

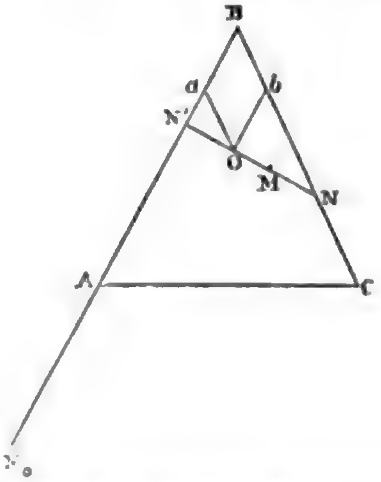
I will therefore leave the question in this state, merely observing that, should Mr. Daintree be unable to obtain the results he is in search of, I shall then claim for our metallic sulphides the sole duty of depositing at least that portion of our native gold which occurs in the reefs or fissures of our metamorphic rocks.

ON THE
LAW OF COLOUR MIXTURES AND THE PHYSIOLOGICAL FUNDAMENTAL COLOURS.

By M. BOUTY.

From physiological researches, and chiefly from observations on individuals who are colour-blind, Helmholtz has been led to enunciate the view that all the colour sensations of which we are susceptible may be awakened by the mixture, in suitable proportions, of three colours, viz., red, green, and violet-blue, which he has named, for this reason, *fundamental physiological colours.* The obscure problem of mixture of colours becomes susceptible, on this hypothesis, of a rational and elegant solution, the principal features of which, as given in a recent memoir by M. Von Bezold,[*] we propose shortly to explain.

Let us take, arbitrarily, in a plane, three points, A, B, and C, to represent the three fundamental colours in order of refrangibility; and let a colour be mixed, containing these three colours in the proportion of the numbers P_1, P_2, and P_3. We may represent it by the point M, centre of gravity of weights respectively equal to P_1, P_2, and P_3, placed at A, B, and C. Thus all colours will be found represented in the interior or in the sides of the triangle without ambiguity; and to each point in the table a determinate colour will correspond.



The binary mixed colours are situated in the perimeter of the triangle; thus, from A to B range orange and yellow tints, from B to C blue tints, and, lastly, from C to A the purple tones resulting from a mixture of red and violet, and which have no representatives in the solar spectrum.

White will be somewhere in the interior, at a point O.

If, from O, we proceed in the direction ON, we pass by insensible degradations, from perfect white to a pure binary colour, a blue, *e.g.*, but all the intermediate colours are characterised by the same *tone* more or less diluted. We may, indeed, consider, all these colours as mixtures of white and of blue; and a point M of the line ON is the centre of gravity of the suitable weights placed, respectively at O and N. We see that the colour N is *saturated*, and we designate, as the *degree of saturation* of the colour M, the relation—

$$\frac{OM}{NO}$$

of its colour intensity to its total intensity.

It will be easily established that two opposite directions, ON and ON', correspond to complementary tones, and that white may result in an infinite number of ways from the combination of two binary or ternary colours.

Just as we may compose and decompose forces into systems varied *ad infinitum*, we may produce the same physiological colour in an infinite number of ways; but, to define it fully, three quantities are always required; either the intensities of the three fundumental components, or certain other three data, subject to the condition of our being able to determine the intensity of a force and its point of application in a plane. The most convenient choice consists, perhaps, in defining a colour by the tone; that is to say, the wave-length of the corresponding binary colour, the intensity of the white light which it contains, and the degree of saturation. For purple tones, which have no proper refrangibility, there is given the wave-length of the complementary green.

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[*] *Athenæum*, July 22, 1871.

[*] *Poggendorff's Annalen*, tome cl., pp. 93 and 121.

The wave-length of a binary colour, N, defining the latter without ambiguity, is a function entirely determined by the position of the point N, but this function is unknown *à priori*. The most simple form which can be given to it is obtained by supposing that the distance of the point N, reckoned from a fixed origin, N_0, in the direction N_0ABC, is proportional to the number, n, of vibrations of the colour. If we provisionally accept this form of the function, we may express, by a very simple relation, the property of complementary colours. Draw, from the point O, the parallels Oa and Ob to the sides BC and AB of the triangle. The similarity of the triangles $N'aO$ NbO gives—

$$\frac{N'a}{aO} = \frac{Ob}{Nb}.$$

Or, putting α and β for the numbers of vibrations corresponding to the colours a and b; n and n' for the numbers of vibrations of the complementary colour NN'—

$$\frac{\alpha - n'}{aO} = \frac{Ob}{n - \beta}$$

$$(n - \beta)\ (\alpha - n') = aO.Ob = \gamma^2,$$

γ denoting a constant. If n and n' be considered as current co-ordinates, this formula represents a hyperbola. Now the researches of M. Helmholtz and M. Müller furnish wave-lengths observed from a great number of complementary colours, and it is verified that the configurative points of each couple of observations are situated sensibly in the same hyperbola. Thus the author's hypothesis is justified.

If one might reckon with absolute exactness on measurements so difficult as the precise determination of complementary colours, the construction of the hyperbola would furnish the values of α and β, that is to say, would determine the position of white on the table; but very small differences in the position of the hyperbola correspond, unfortunately, to considerable variations of the parameters α and β. We can only, then, accept the results with some reserve. We have, according to the author, $Oa = Ob$; that is to say, white will be found in the bisecting line of the angle ABC. The number of vibrations, n_2, of the fundamental colour B will thus be—

$$n_2 = \frac{\alpha + \beta}{2},$$

and will correspond to 596 billions of vibrations per second. This number is exactly the mean of the numbers of vibrations corresponding to the extremities of the spectrum.

Considerations still less certain than the preceding lead to our adopting, for n_1 and n_3, corresponding to the fundamental colours A and C, the numbers 465 and 725 billions per second. The mean of these numbers being exactly 596, the table of colours will be an isosceles triangle, and, as the length of the side AC is indeterminate, we may make the triangle equilateral.

It remains to place in the table the spectral colours themselves. On account of the uncertainty of the data on which rests all this part of the memoir, we must refer the reader to the original work. He will find, on this subject, and more generally on the physiological theory of M. Helmholtz, a large number of interesting details; in particular, an indication of the experiments which should be made in order to dispel the uncertainties that still abound in this curious chapter of physics.—*Journal de Physique.*

MISCELLANEOUS CHEMICAL NOTES,

By S. DANA HAYES,
State Assayer for Massachusetts.

I. *Deposits in Boiler Tubes.*

The causes of frequent failure and leakage in the small iron flue-tubes in tubular steam boilers have lately been investigated by expert engineers, and analyses made of the deposited materials found in these tubes, both before and after they have failed, indicate the cause of failure in many cases. These tubes are cleaned at intervals, when the boilers are in use, with cylindrical wire brushes, and when only dry dust or a little soot is drawn out by these brushes the tubes may be considered to be in good condition. But there are frequently deposits in the tubes that are pasty in places and roll along under the cleaning brush like pieces of dough, or the quantity of dry powder deposited in the tubes may be quite large; in such cases there is danger of rapid corrosion and weakening of the iron, and analysis should be made of the deposited material removed by the brushes in order to determine its nature and source.

These deposits are of two kinds, both of which are capable of corroding the iron rapidly, especially when the boilers are heated and in operation. The most common one consists of soot (nearly pure carbon), saturated with pyroligneous acid, and contains a large proportion of iron if the deposit is an old one, or very little iron if it has been recently formed. The other has a basis of soot and fine coal-ashes (silicate of alumina, &c.), filled with sulphur acids, and contains more or less iron, the quantity depending on the age of the deposit.

The pyroligneous deposits are always occasioned by want of judgment in kindling and managing the fires. The boilers being cold the fires are generally started with wood, and when partially under way they are nearly extinguished ("smothered") with large charges of coal or wood; pyroligneous acid then distils over into the tubes, and, collecting with the soot already there from the first kindling fires, forms the nucleus for the deposits, which soon become permanent and more dangerous every time wood is used in the fire places afterwards. If the coal or wood is not used in excessively large charges nothing but dry soot collects in the tubes, and much of this is ultimately burned or carried into the chimneys by the hot draft from the fires. The sulphuric deposits derive their acids from the coals used, but the basis material holding these acids is at first occasioned by shaking or cleaning the grates soon after adding charges of fresh coal to the fires, and by thus driving fine ashes forward into the small flues at the opportune moment for them to become absorbents for the sulphur compounds distilling from the coals, and corrosion of the iron follows rapidly after these deposits.

In one instance considerable quantities of sulphur acids were found in the tubes of a boiler where no coal had been used, but it was discovered that the fuel employed consisted largely of old staves and boxes impregnated with alum, copperas, sulphate of copper, &c. In other cases small particles of distilled sulphur have been found in the tubes.

It is obvious from what I have written that the fires under tubular boilers should be managed with more judgment than is usually bestowed upon them; the fuel should never be used in large charges at one time, but the fires should be frequently renewed with smaller charges; and the grates should be cleaned only when the fires are bright on top.

II. *Lignite from Louisiana.*

Brown coal, of which there are considerable deposits in the banks of the Mississippi river, about two miles below Shreveport, in Louisiana, has been recently proposed as fuel for the steamboats on the rivers. Analyses of air-dried specimens representing these deposits have yielded the following average results:—

100 parts contained—

Water	15·26
Volatile matter (bituminous)	41·30
Fixed carbon (coke)	37·55
Sulphur (merest traces)	—
Ash	5·89
	100·00

This lignite has a specific gravity of 1·143, it is nearly black in colour, and its ligneous structure is not so distinct as usual, but it dissolves completely in caustic soda solution.

III. *Waters of Prince Edward Island, Nova Scotia.*

There is probably no city of 10,000 inhabitants on this continent that is suffering more for want of pure water than Charlottetown, the capital of Prince Edward Island. The public and private wells of this city are unfit for use from the presence in them of animal matters in uncommonly large proportions, and they undoubtedly constitute the primary cause for some of the diseases prevailing among the people there. The inhabitants of this city are literally "dependent upon a water cart or two and a spring just out of the city limits for every drop of water fit to use for cooking or drink;" and this water, which is itself not by any means one of the best, is sold from the carts for nearly 1 cent per gallon. For more than two years the city council have had this matter under consideration, and the first complete analyses of their waters were made in November, the sources of the different specimens being unknown at the time. In recording only partial results of these analyses, it should be understood that the constituents called *organic matter* consist of the volatile matters after correction and deduction of carbonic and nitric acids, water of composition, &c., belonging to the mineral and saline constituents determined by full analyses.

One United States gallon (231 cubic inches) of these waters contained in grains—

Source of Waters Analysed.	Inorganic Matter.	Organic Matter.	Total Weight of Residue.
City pump well	50·61	5·95	56·56
Park spring	5·05	3·17	8·22
Winter river, six miles from the city	4·21	2·46	6·67

The well water contained nitrate of potash in sufficient quantity to admit of its separation by crystallisation; and the predominating constituent in the residues from the other specimens was sulphate of lime. There is now every reason to suppose that the water of Winter river will be brought into Charlottetown before long, through a proper system of supply pipes, although the same partisan feeling on the "water question" finds expression there as elsewhere.

IV. *Opium in Commercial Medicines.*

The attention of public health officers has been drawn to the increasing consumption of opium and morphia in the cough mixtures, tooth washes, lotions, liniments, and other preparations now so freely offered for sale by vendors of patent medicines; and, as the subject is one of importance, brief mention of these few cases, among others that have come under my observation, will not be out of place.

Some analyses, recently made here of medicines intended for internal use, have shown the quantity of morphia present in several of them to vary from ¼ grain to 1¼ grains in the dose recommended by the printed directions accompanying the medicines. One nostrum, a sure "Cure for the Opium Habit," was found to be a clear solution of sulphate of morphia, coloured pink by aniline red, and sweetened with sugar; and a dose, containing very nearly 2 grains of sulphate of morphia, was to be taken three times a day by the patient when suffering severely from depression and other symptoms. The "brandy," sold by a dealer of medicines in the country, was found to have been mixed with laudanum and extended with water in such proportion as to insure large profits, but it contained morphia equal to 2¼ grains of opium in 4 fluid ounces of the "brandy." A tooth-wash contained nearly four-tenths of a grain of morphia in each fluid ounce; and a cough mixture more than three-tenths of a grain in the dose directed for a child.—*American Chemist.*

NOTICES OF BOOKS.

Physiology. By F. LeGros Clark, F.R.S. London: Society for Promoting Christian Knowledge.

A treatise on animal physiology, even as applied to the human species alone, cannot, without great concision, be compressed into the brief compass of 126 pages. As a matter of course only the leading facts of the science are given. To the trained student it must also seem strange that one group of organs and their function have, probably in obedience to the Essene traditions which linger more strongly in England than in any other civilised country, been altogether omitted. To seek for errors in an account of the human frame and its functions drawn up by such an authority as Professor Clark would be idle in the extreme. Many interesting questions which the modern development of science is bringing more and more into prominence, are either merely glanced at, or totally overlooked. But regard being had to the obvious destination of the work, it may be said that abstruse researches and still more doubtful views would here be out of place.

Dr. Pereira's Elements of Materia Medica and Therapeutics. Edited by R. Bentley, M.R.C.S., F.L.S. and Theoph. Redwood, Ph.D., F.C.S. London: Longmans, Green, and Co.

On a work of a character so established as that of Dr. Pereira's little need be said. The present edition has been improved in its arrangement, and brought up to the present state of chemical and pharmacological knowledge.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and Jas. Braithwaite, M.D. Vol. LXIX., Jan. to June, 1874. London: Simpkin and Marshall.

We quote from this work a notice of the remarkable solvent action of Papya juice on the nitrogenous articles of diet. Dr. G. C. Roy having found that in India cooks are accustomed to add a few drops of the milky juice of Carica papya to tough meat to make it tender, instituted a variety of experiments on the subject. He found, in fact, that the drug has a remarkable disintegrating power upon animal matter, without, however, promoting putrefaction. It may, not impossibly, be a nitrogenous ferment, standing in the same relation to albumenoid bodies as yeast does to starch. The plant does not appear to possess any poisonous properties, and the meat which had been the subject of the author's experiments was repeatedly eaten by a cat without injury.

CORRESPONDENCE.

PRECIPITATION AND ESTIMATION OF FATS.

To the Editor of the Chemical News.

Sir,—In reference to my letter on this subject in Chemical News, vol. xxx., p. 135, a slight printer's error occurs; instead of a room heated to 680° F., it ought to have been 68° F.

Further experiments have proved that half an hour suffices to effect the full precipitation of fats from their ethereal solutions by the addition of twenty drops or so of alcohol to the dram of ether, containing not more than 25 grains of the adulterated butter; after which the tube should be agitated and its contents projected on to a small double filter, washed with a little alcohol, and the residue, whilst moist, scraped off and transferred to a watch-glass to dry. In this way, loss by melting and absorption into the paper is obviated.

The following were the proportions of the fats I recovered, viz.:—

Lard	60 per cent.
Mutton fat	75 „
Beef	95 „

The precipitated mutton fat is powdery, and as white as snow. Lard and beef are more adherent and greasy; from that reason mutton makes the firmest compound.—I am, &c.,

John Horsley.

Cheltenham, September 19, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 5, August 3, 1874.

Double Series of Drawings Representing Terrestrial Whirlwinds and Solar Spots.—Executed by M. Faye.—Not adapted for abstraction, as frequent reference is made to the figures.

Eighth Note on Guano.—M. E. Chevreul.—The author states that until recently he had not detected in guano any compound of sodium except the chloride, mixed with chloride of potassium. Recently he has found in guano the ammonia-phosphate of soda. The salts which he has hitherto recognised in guanos are—carbonate and hydrochlorate of ammonia, phosphate, oxalate, and urate of lime, avate of potash, and two or three salts of potash, the acids of which are volatile, and smell like phocenic acid and its analogues. The following double salts are certainly present:—Ammonio-oxalate of potash, ammonio-sulphate of potash, ammonio-phosphate of soda, ammonio-phosphate of magnesia. The occurrence of the ammonio-phosphate of potash is doubtful. Chlorides of sodium and potassium are also present.

Meteorite which fell May 20, 1874, at Virba, near Vidin, in Turkey.—M. Daubrée.—The fall was attended by a loud noise. The mass, weighing 3·6 kilos., penetrated into the soil to the depth of 1 metre. It is entirely covered with a dull black layer. Its fracture is stoney, of a light grey, finely granular, and rough to the touch. In the mass are scattered numerous grains of a metallic lustre. In thin layers the stoney grains are transparent, nearly colourless, and act upon polarised light. The metallic portion consists of iron-grey irregular grains of nickeliferous iron, with which are mixed sulphide of iron, and numerous minute grains of chrome iron. The non-metallic portion forms a jelly with weak hydrochloric acid after the manner of peridote.

Indication of a Method for Determining the Properties of the Ether.—M. X. Kretz.—In order to explain certain classes of physical phenomena we have, in general, recourse to the hypothesis of an inert and imponderable medium extending through space, and which has received the name of ether. For a certain time, and especially since the discovery of the principles of thermo-dynamics, the attempt has been made, in certain mechanical theories, to introduce the consideration of ether, or that of some other element having an equivalent mode of action. In such attempts the new hypothesis has been placed in juxtaposition with dynamics, without examining if the method adopted is legitimate. The author shows that the supposition of an element exterior to matter is irreconcilable with the definition of matter, as it results from the fundamental principles of dynamics. If we then find it useful or necessary, for the explanation of certain phenomena, to assume that beyond matter there exists another element or medium of whatsoever constitution, it becomes at the same time needful to modify the interpretation of the bases of mechanics, so that the whole of the doctrine may repose upon compatible principles.

Thermic Effects of Magnetism.—M. A. Cazin.—If m is the quantity of temporary magnetism of an electro-magnet, l the polar interval, Q the number of calories created by the disappearance of the magnetism, A a coefficient constant for the same magnetising coil, and the same disposition of the circuit, then $AQ=m^2l$. If the magnetism is only employed to produce heat in the nucleus, the coefficient A will be constant, and will measure the number of unities of magnetic energy equal to 1 calorie. This will be the magnetic equivalent of heat. To find it, it is necessary to find the absolute value of Q and of m^2l. The author has made two series of experiments for this purpose, the first to ascertain if A is a constant, and the second to find the value of Q.

Researches on Explosives.—M. Noble and F. A. Abel.—A continuation of the first memoir of these two chemists.

Fourth Note on the Electric Conductivity of Woody Bodies.—Th. du Moncel.—The object of the present paper is the study of the variations of the conductivity of woods, according to the length of the section.

Passivity of Iron.—P. de Regnon.—The author made use of iron wires protected, for a certain length, by glass tubes or layers of varnish. The free extremity, for the length of 2 to 3 centimetres, could be entirely plunged into the acid. An electric current entering by the iron into any nitric acid soever, renders it passive as long as the current lasts, with liberation of oxygen almost pure. On breaking the current the iron remains passive. A current taking its exit by the iron destroys the passivity—a change of condition which may be repeated indefinitely. Iron acting as positive electrode in a mixture of sulphuric acid and water liberates oxygen, is slightly attacked, and is rendered passive for nitric acid. A reversal of the current destroys the passivity. The action of nitric acid upon iron may be stopped by touching it, or better by rubbing it within the acid with a conducting body not attacked by the acid, such as platinum or charcoal. This action of carbon explains why steel and cast-iron become spontaneously passive. The more concentrated the acid, the more readily passivity is produced. The contact of an attackable metal destroys passivity. If, therefore, we bring in contact two iron wires, the one passive and the other active, the result may be either the passivity or the attack of both. The end of a wire may be washed in water without destroying its passivity, provided care is taken not to immerse the wire beyond the protecting varnish. The wire may even be scraped under water with another passive wire, or with the end of a clean glass tube, without altering its condition. This experiment completely overturns the explanation of passivity by the assumed formation of an insoluble layer on the surface of the wire. Oxidising agents are without action upon passive wire, but deoxidising bodies destroy the passivity. Most causes which produce passivity may be reduced to a voltaic force carrying the oxygen to the iron, and polarising it upon the surface of the metal. On the other hand, the majority of the causes which destroy the passivity of iron may be reduced either to a voltaic force in the opposite direction, or to a current due to the polarisation of the oxygen, and by which it is exhausted; or, lastly, to an absorption of the polarised gas by a body greedy of oxygen. We can now understand two experimental precautions insisted on above. It is necessary to protect the portion of the wire not plunged into the acid by an impenetrable coating, otherwise the acid vapours would place this portion in a state opposed to the passivity of the immersed portion. Again, when washing the passive extremity in water; if the metal is immersed beyond the varnish we close a circuit, by which the polarisation is exhausted, and the passivity destroyed.

Certain Minerals of Bismuth and Tungsten from the Mine of Meymac (Corrèze).—A. Carnot.—The sulphide of bismuth from this mine is distinguished from ordinary bismuthine by a lead colour, verging upon blue, like that of sulphide of antimony. Its sp. gr. is 6·60. Its composition is—

Bismuth	78·40
Lead	0·75
Copper	0·40
Iron	0·53
Antimony	0·85
Arsenic	3·10
Sulphur	14·25
Gangue	0·90
	99·18

The mineral contains neither tellurium nor selenium; some samples show traces of cobalt. This analysis points to a formula distinct from that attributed to bismuthine, Bi_2S_2. It may be considered as a new species—

$$16(Bi,Pb,Cu_2,Fe)S+(Sb_2,As)S_3.$$

Hydrated carbonate of bismuth, found in abundance in the mine, is produced by the alteration of the sulphide by atmospheric agencies. It preserves the half-fibrous, half-lamellar condition of the original mineral. Its sp. gr. varies from 6·81 to 7·20. Its colour is grey, greenish grey, or whitish yellow. It is readily attacked by acids, with effervescence, yielding a yellow solution. Three samples were analysed:—I. Greyish white; sp. gr. 6·94; II. deep grey, fibrous, sp. gr. 7·26; III. white, earthy, sp. gr. 7·08.

	I.	II.	III.
Oxide of bismuth ..	89·75	87·50	86·90
Oxide of lead	0·55	0·44	0·40
Oxide of copper	traces	,,	,,
Oxide of iron	0·53	0·50	0·43
Lime	0·35	0·55	0·38
Magnesia	traces	0·07	0·05
Sulphuric acid	0·25	0·22	0·13
Arsenic acid	0·73	0·80	0·65
Antimonic acid	0·57	1·25	1·20
Hydrochloric acid ..	0·37	0·20	0·14
Carbonic acid	3·74	4·15	5·35
Water	2·76	3·55	3·02
Gangue	0·20	0·30	1·10
	99·80	99·53	99·57

This mineral evidently belongs to the same species as the "Bismuth Ochre" of Schneeberg, and the bismuth spar or bismuthite of South Carolina.

Photographic Reproduction of Microscopic Crystallisations.—M. J. Girard.—The arrangement would be more intelligible if accompanied with an illustration.

Isoterebenthen from a Physical Point of View.—M. J. Ribau.—The author gives the boiling-point, rotatory power, density at different temperatures, and index of refraction.

Constitution of Ordinary Bromated Propylen.—M. E. Reboul.—Not adapted for abstraction.

Action of Nitric Acid upon Paraffin; Products Resulting.—A. G. Pouchet.—The paraffin is converted into paraffinic acid, a solid, yellowish white body, insoluble in water, soluble in alcohol, ether, chloroform, benzol, &c. The acid fuses at 45° to 47°, and at temperatures slightly higher is decomposed.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 15, 1874.

The Moon and Mycoderms.—M. Charbonnier asserts that at the period of the equinoxes the water of aquariums becomes greenish, and the sides grow dirty to such an extent that they require cleaning several times daily to preserve their transparency. These germs produce a periodical mortality among fish, which the author ascribes to the sudden and disproportionate growth of mycoderms at the time of the full moon, and especially at the equinoxes.

Identity of the Period of Photospheric and Magnetic Phenomena in Connection with the Proper Movement of the Sun.—P. Rosa.—The secular photospheric and magnetic variations undergo a simultaneous oscillation of a period of 66½ years. The perigee of the apparent orbit of the sun oscillates according to the same period. The decennial period, according to Lamont and Sabine, or the endecennial according to Wolf, Hansteen, and Quetelet, connects not only the magnetic variations and the solar activity, but also the variations of the diameter of the photosphere. Although the period of the above-mentioned oscillation remains approximately the same the mechanical perturbations of the solar perigee, and the changes of photospheric form, as well as the intensity of terrestrial magnetism, demonstrate evidently that the solar system is at present removing from the seat of the force which produces the phenomena in question. It follows that this force centres in a celestial body outside the planetary system.

Action of Atmospheric Vapour on the Heat, whether Luminous or Obscure, of the Solar Radiations.—F. S. Provenzali.—The author finds that the luminous heat and the dark heat do not maintain a constant relative relation, but that the one often increases while the other diminishes.

Reimann's Farber Zeitung, No. 25, 1874.

This number contains instructions for dyeing feathers black and brown; for an alkali (Nicholson) blue on old silks; for dressing cleaned and re-dyed velvets; for printing steam reds and roses (cochineal and peach-wood) on calico; for dyeing a swallow-blue on woollen piece goods; and a bright green on woollen yarn.

No. 26, 1874.

This number contains a continuation of the article on dyeing and finishing plushes; receipts for a buff and a mode grey on garments (cotton warps), and a rose-brown on woollens; a curious receipt, extracted from a contemporary, for producing an orange on silks by working for three quarters of an hour in nitric acid at 5° B., and then for a quarter of an hour in a soap-bath; a blue without indigo on wool to stand milling, which we give at length. For 120 lbs., boil two hours with 3 lbs. blue vitriol, 3 lbs. salts of sorrel, 15 lbs. alum, 6 lbs. tartar, and 2 lbs. chromate of potash. Let cool in the dye-liquor, and then boil for two hours with 56 lbs. campeachy logwood. This colour not only resists milling, but takes a finer blue tone from that process.

Aniline Blue Printing Colour for Cottons.—

Acetate of alumina at 14° B.	1 litre.
Bisulphite of soda at 25° B.	1 ,,
Strong gum-water..	2 litres.
Aniline blue	100 grms.
Hot water	½ litre.

The calico may either be printed with this mixture without any previous preparation, or it may be padded in soap-lye containing 50 grms. of white soap per litre. Pieces thus prepared take the colour better. After printing dry, steam for an hour and a half, wash, pass quickly through soap-lye at a hand heat, and clear in water slightly acidulated with hydrochloric acid, rinse, and dry. This method completely replaces the common and dangerous arsenical process.

Then follow receipts for "topped" vat-blues on mixed goods (cotton warps), and general instructions for woollen dyeing.

Aniline Blacks.—According to Kruis, of Prag, all the heavy metals produce a black colour by their action upon the chlorate of aniline. Either immediately, or on the application of heat, a dark green insoluble pigment is produced, which, on exposure to the air, turns black or dark grey. If the residual liquid is filtered off, it is found to contain magenta. A brown colour is also produced, soluble in alcohol. Few metals, however, are suited for producing a deep black on the fibre. Besides copper, which is generally employed, there are only cerium, iron, and manganese. Uranium gives only a grey. Cobalt and arsenic yield dark blue tones. Gold, platinum, antimony, molybdenum give medium blues. Light grey is produced by uranium, tin, chrome, nickel, bismuth, lead, and zinc. These statements cannot be quite correct, since the salts of chrome are widely and successfully employed in print-works for the production of a fine aniline black.

No. 27, 1874.

This number contains an editorial note on the unsatisfactory state of the tinctorial trades; the causes enumerated being competition in low charges, the doubtful condition of textile manufactures, and the recent rise in wages. There are receipts for a red, black, brown, and green upon woollen yarn, all capable of bearing milling; an olive on woollen yarn and pieces; a blue for printing on cotton and mixed pieces; and a salmon and a stone colour on cotton yarns.

Aniline Black.—According to Kruis, the aniline black developed by bisulphate of cerium surpasses all others in intensity, brightness, and fastness. The material is expensive, 12s. per kilo. The amount required is only one-fourth or one-fifth part of the weight of sulphide of copper commonly used. The action is rapid, and the fibre is not at all injured. The colour becomes merely a dark green in the ageing house, and only takes a full black in the alkaline bath. The instructions for working the new indigo vat of Schützenberger and Lalande will be given when completed.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, March and April, 1874.

Assay of Commercial Sulphate of Soda.—L. L. de Koninck.—Commercial sulphate of soda may contain, besides the normal salt, bisulphate of soda, salts of potash, sulphates of iron, alumina, lime, and magnesia, common salt, water, and insoluble matters. The salts of potash are considered as salts of soda. Free acid includes half the acid of the bisulphate of soda, and all combined with alumina and iron, the whole calculated as SO_3. The sulphate of soda is determined by difference.

Insoluble Matter.—Weigh 50 grms. of the sample, dissolve in 600 to 700 c.c. of distilled water, and filter into a flask marked at 1 litre. The insoluble matter remaining on the filter is washed into the flask, dried, and weighed after incineration. We do not in this manner obtain the full amount of the insoluble matters, since some of them are combustible, and are lost during ignition.

Free Acid.—The filtrate is made up to 1 litre, and well stirred so as to be homogeneous. By the aid of a pipette 300 c.c. are taken, placed in a beaker, and titrated with standard alkali in the usual manner.

Alumina and Oxide of Iron.—200 c.c. of the filtrate are taken, and mixed with bromine-water to peroxidise the iron. Precipitate with ammonia, and weigh the mixed deposit of alumina and ferric oxide in the usual manner.

Sulphate of Lime.—To the filtrate from the alumina and oxide of iron oxalate of ammonia is added. The precipitate is collected on a filter, washed, ignited, treated with a few drops of sulphuric acid, diluted with an equal volume of water, ignited again, and weighed as sulphate.

Sulphate of Magnesia.—To the liquid freed from lime ammoniaco-phosphate of soda is added. The precipitate formed is converted by ignition into pyro-phosphate of magnesia, 1 part of which represents 1·08 of sulphate. Chloride of sodium is determined by titration in the well-known manner with nitrate of silver, using chromate of potash as indicator. Water cannot be determined directly, for before the water is expelled the bisulphate of soda reacts upon the chloride of sodium. The sample is therefore heated to fusion, and the known amount of free acid deducted from the loss. A correction is still required on account of the loss of hydrochloric acid. For every 117 parts of chloride decomposed by fusion we must add to the loss 23 parts. To find the quantity of chloride thus decomposed, we dissolve the sample after fusion, and re-determine the chlorine.

May and June, 1874.

Experimental Researches on the Laws of Filtration.—P. Havrez.—A mathematical paper, not adapted for abstraction.

Resistance of Phosphor-Bronze, and on its Industrial Applications.—Alphonse Polain.—Two mixtures are given for depositing platinum upon phosphor-bronze. (1) Dissolve 10 grms. platinum in aqua regia, evaporate to a syrup, re-dissolve in 2 litres of water, and add 150 grms. phosphate of ammonia, and 500 grms. phosphate of soda. The reaction of the bath is alkaline. It is heated, without letting it rise to the boiling-point (which would cause the precipitation of the platinum), until the solution has an acid reaction, and all the precipitate is re-dissolved. (2) Dissolve 10 grms. of platinum in aqua regia—

$$(2HCl+NO_5HO),$$

evaporate to a syrup, re-dissolve in 2 or 3 litres of water, add 20 grms. caustic potash and 40 grms. oxalic acid, and heat for five or six hours to 60° or 80° C. The solution becomes clear, and the precipitate is re-dissolved. Potash is then added in sufficient quantity to give an alkaline reaction, when the solution is filtered, and used cold. Two Bunsen elements are sufficient for either mixture.

Note on Phosphoric Steels.—Adolphe Greiner.—Phosphoric steel was first made at Cainsdorf, near Zwichau, Saxony. The crude metal employed contains on an average the following impurities:—

Silicon	2·50
Sulphur	0·04
Phosphorus	0·10 to 0·12
Manganese	2·60 „ 4·06
Carbon	3·50

Manganese appears to be an antidote to phosphorus. The average composition of the Zwichau steels is—

Silicon	0·40 to 0·70
Sulphur	0·06
Phosphorus	0·10 to 0·15
Manganese	0·40 „ 0·70
Carbon	0·15

Experience shows that if the phosphorus exceeds 0·20 per cent the steel is too brittle. It seems that phosphoric steels may play a certain part in siderurgic industry, which, however, must not be exaggerated.

Influence of Chlorine upon the Properties of Certain Metals.—C. Kunzel.—The author shows that in nickel, iron, and zinc small quantities of chlorine, say 0·13 per cent, may be the unsuspected cause of failure in working these metals.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the process of obtaining potash from the "yolk" of wool, and from the residuum of the distillation of beet-root juice or of molasses, and in apparatus for the same, which improvements are also applicable to the recovery of soda from the lyes of paper pulp. Hunter Henry Murdock, patent agent, Staple Inn, Middlesex. (A communication from Auguste Louis Joseph Lesage, chemist, Brussels, Belgium.) January 7, 1874.—No. 97. This invention consists of improvements in the treatment in the "yolk" of wool, and the residuum of the distillation of beet-roots and molasses, in order to obtain potash therefrom, and of apparatus and furnaces for such treatment. The liquor to be operated on is subjected to evaporation by being made to pass through a series of evaporating pans or boilers; it then enters a preparatory furnace, from which it passes into an incinerating furnace in which the potash is obtained. The potash is then removed to a cooling chamber or building, formed on three sides by double perforated walls with an air span between them and closed on the other side by a door, the floor being made of bars or girders, sufficiently far apart to allow of a circulation of air. The first evaporating pan or boiler is mounted above the preparatory and incinerating furnace, and is heated thereby. The incinerating furnace, which is constructed next to the preparatory furnace, is heated by a suitable fire-grate or furnace, which also heats one of the evaporators; a second fire-grate or furnace gives heat to another evaporator, and also consumes the volatile products of combustion from the incinerating furnace, which products of combustion first traverse the preparatory furnace. Other evaporators are heated by separate fire-grates or furnaces. The flues from all the fires open into a terminal flue heating the last of the evaporators, in which flue the products of combustion from the different sources mingle and are consumed.

Improvements in the extraction of quinine from bark. Albert Augustus Deiss, machine maker, Fish Street Hill, London. January 10, 1874.—No. 147. This Provisional Specification describes extracting quinine from bark by a hot process. The bark to be treated is placed in a close vessel, and the vapour of alcohol or other solvent is admitted at the top, and permeates amongst the bark and condenses to form an extract, which runs out at the bottom, from which extract the quinine is obtained.

Improvements in treating sewage-water and other foul liquids. Augustus Edward Schmersahl, manufacturing chemist, Manchester, Lancaster. January 12, 1874.—No. 160. The features of novelty in this invention consist in precipitating all the useful matters in solution or suspension in such liquids by means of a mixture of acids, say 2 parts of sulphuric acid mixed with water, and 1 part of hydrochloric acid, which is added thereto in sufficient quantity to decompose such matters, when milk-lime is added to neutralise the liquid, and the precipitate immediately falls, leaving the effluent water pure and odourless.

Improvements in the method of condensing muriatic acid gas and other fumes. Robert Stirling Newall and Henry Bowman, Washington Chemical Works, Newcastle-on-Tyne. January 13, 1874.—No. 165. The gas is condensed by being admitted into small low chambers, and having injected amongst it water divided into the finest spray, so as to bring the largest surface of water in contact with the gas and produce a rapid condensation.

Improvements in the manufacture of soda in revolving furnaces. William Black, Hedworth, near South Shields, and David Hill, East Jarrow, South Shields, Durham. January 13, 1874.—No. 173. The essential feature of this invention consists in heating the mixture of sulphate of soda, carbonate of lime, and small coal in such a manner as to prevent the formation, as far as possible, of caustic lime: and this may be accomplished by putting the whole mixture of sulphate of soda, carbonate of lime, and small coal into a revolving furnace together, or by heating the carbonate of lime by itself, but stopping short in the heating at that point at which it begins to give off carbonic acid and forms lime, and then adding the sulphate of soda and small coal.

Improvements in the treatment of substances containing alumina, so as to render them more suitable for the production of aluminous compounds. George Archbold, D.Sc., analytical and consulting chemist, Spittal, Berwick-on-Tweed. January 15, 1874.—No. 200. This invention relates to the treatment of substances containing alumina, such, for example, as china clay, so as to render the alumina contained therein more suitable for the production of aluminous compounds and products, and consists in subjecting the substances containing alumina, such as china clay, to a drying process, and when sufficiently desiccated reducing the same to a fine state of division by any well-known methods. The finely-divided clay is then incorporated with spent hops, spent malt, unmalted grain, sawdust, charcoal, or any combustible porous substance, and the mixture is then impregnated or saturated with a hydrocarbon, such, for example, as heavy coal-oil or other economical natural products, or the results of the distillation of carbonaceous materials. The materials so mixed and incorporated are then subjected to the action of heat, either in a reverberatory furnace or otherwise, when it will be found that the aluminous constituent of the clay thus prepared will be more easily attacked by sulphuric and other acids, and that a neutral sulphate of alumina can be obtained therefrom.

Improvements in the manufacture of bichromate of potash. George Smith, chemist, Newcastle, Northumberland. January 17, 1874.—No. 224. The novelty in this case consists in obtaining a more intimate of the chromate of iron ore and alkali by dissolving the alkali before mixing it with the ore, and in the addition of unburnt Irish lime to the compound, and also in the use of carbonate of soda as part of the alkali.

Improvements in the manufacture of white lead. Bernard Charles Molloy, barrister-at-law, Temple, and Desmond Gerald Fitzgerald, electrician, Brixton, Middlesex. January 21, 1874.—No. 266. The essential features of this invention consist in the production of what is known as white lead, carbonate of lead, or basic carbonate of lead, by effecting the decomposition of chloride and of oxychloride of lead by means of an earthy carbonate, or by means of an earthy carbonate in conjunction with an alkaline earth, or the hydrate of the same.

Improvements in the treatment of sewage and ammoniacal liquids. Major-General Henry Young Darracott Scott, C.B., and John Berger Spence, merchant, Manchester, Lancaster. January 22, 1874.—No. 283. The object of this invention is the treatment of sewage and ammoniacal liquids so as to abstract therefrom the ammonia present in a cheap, portable, and stable form. When the liquid to be operated on has been clarified by removing the suspended matters by subsidence or precipitation, we pass the clarified sewage through layers composed of natural phosphate of iron in the hydrated condition, or of phosphate of iron. The phosphate salt or salts are then allowed to subside in combination with the ammonia abstracted from the liquid.

Improvements in the production of tannin and canocarpine. Paul Philippe François Michea, Leadenhall Street, London. January 23, 1874.—No. 284. This invention relates, firstly, to a process for the production of tannin from tannin-bearing plants, trees, fruits, leaves, barks, or extracts thereof; and, secondly, to the application of such process to the production of a substance known as canocarpine; a process for the production of which from the leaves of the *Canocarpus latifolia* was described in the Specification to a Patent dated September 20, 1872, No. 2786. The tannin contained in the said plants, trees, &c., is first extracted by decoction or maceration in an aqueous solution of common salt, or in sea-water, or in a solution of sulphate of soda, to which about 1 per cent of a soluble salt of lime or magnesia is added. From the liquid thus obtained the tannin is precipitated by the addition of an alkali or alkaline earth. The tannin compound thus precipitated is washed, and is then suspended in water, and by the gradual addition of a free acid the precipitate is dissolved, and a solution of tannin is obtained, giving all the usual reactions of tannin. For producing canocarpine from the leaves of the *Canocarpus latifolia*, a decoction of the said leaves is subjected to fermentation until the tannin is destroyed, and the fermented liquid is then subjected to the above-described process for the production of tannin, whereby a solution of canocarpine is obtained ready for use as a dye-stuff.

Improvements in the manufacture of anthracen. Ernst Friedrich Richard Lucas, consulting chemist, Coatham, Redcar, York. January 24, 1874.—No. 317. Under this invention anthracen is obtained from the heavy coal-tar oils which distil at from 260° to 360° Celsius, by passing the same, or the vapours thereof, through pipes or retorts previously raised to a red heat. The heated surface is increased by filling the pipes or retorts with pieces of fire-brick. The oil obtained by this operation is submitted to distillation, and the distillate which passes over after 360° Celsius, is collected separately, cooled, and pressed, the press cake thereby obtained being crude anthracen. The liquid oil resulting from this distillation is again passed through red-hot pipes or retorts, and another portion of anthracen is obtained therefrom.

An improved process of bleaching animal glue of all kinds. Antonio Muzzarelli, merchant, 82, Boulevart Sébastopol, Paris. January 26, 1874.—No. 324. This invention relates more especially to glues made from rabbit skins for use in dressing white tissues. When the glue is prepared and decanted into tubs, a solution of sulphate of soda is poured into the moulds, and mixed with a spatula so as to make a uniform mixture. A solution of acetate of lead is then added, which produces a fine precipitate of sulphate of lead; it is then allowed to cool, and the whiteness of the jelly will be proportionate to the admixture of the sulphate or acetate. The glue thus bleached and destined for desiccation is then cut up and dried in the usual manner.

STUDENTS' CLASS-BOOKS.

Rymer Jones's General Outline of the Organ-ISATION of the ANIMAL KINGDOM. Fourth Edition, £1 11s. 6d.

Frankland's Lecture Notes for Chemical STUDENTS. Second Edition. Vol. I. (Inorganic), 4s.; Vol. II. (Organic), 5s.

Attfield's Chemistry: General, Medical, and PHARMACEUTICAL; including the Chemistry of the British Pharmacopœia. Fourth Edition, 12s. 6d.

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JOHN VAN VOORST, 1, Paternoster Row.

THE CHEMICAL NEWS.

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ON THE DECOMPOSITION OF EGGS.

By WILLIAM THOMSON, F.C.S.

These researches were commenced by the late Dr. F. Crace-Calvert and myself about the beginning of October, 1870, and extended over the following year and a half. Many series of experiments were made with the view to ascertain the effects of certain influences on the decomposition or putrefaction of eggs, but in this memoir I shall state the results of our experiments generally.

We found that the contents of eggs, when their shells were intact, could only be decomposed by one, two, or all of three different agencies.

To the first we gave the name of "putrid cell," to the second "vibrio," and to the third "fungus" decompositions.

The first, or *Putrid Cell* is capable of being developed within any egg, no matter how effectually its shell be protected from the introduction of spores from without, or from the diffusion of gases. It is generated from the yolk; in some cases the yolk begins to swell and absorb most of the white; in others the yolk bursts, and its whole substance becomes thoroughly mixed up with the white; and in others, again, it begins to change slightly, and then gives off cells into the white, rendering the white turbid; and in all cases where this ferment takes thorough hold of the albumen, true putrefaction commences, and the albumen emits a putrid smell. The minute granules or cells of the healthy yolk assume, only in some eggs, a morbid vitality; they grow large and become filled with small cells; the large, or parent cell, bursts, and each separate cell then takes an independent existence, which in its turn again follows the same mode of development. This cell appeared to us to be the bioplasm, or cells of the yolk, which, had the egg developed into a chicken, would have gone to form its flesh, bone, and tissues.

Certain gases seem to have the effect of retarding or preventing its growth, such as carbonic dioxide and coal-gas, but oxygen facilitates it. It converts oxygen into carbonic acid. The following experiment may be cited:—An egg was placed in a bottle of pure oxygen on the 8th of March, 1872, and examined on July 5th, 1872 (after 118 days). The bottles used for these experiments were of 18 ounces capacity, fitted with large firmly-fitting india-rubber corks, from which the eggs were supported by wires. Each had two tubes penetrating the corks, the one going to the bottom of the bottle, the other merely penetrating the cork. When the egg had been introduced, the bottle was taken mouth downwards, and oxygen passed into it by the longer tube, making its exit, accompanied with the air previously present, by the shorter one. After passing the gas for twenty minutes, a little was passed direct from the bottle into an eudiometer and analysed, and found to contain 99·75 per cent of pure oxygen. The exit-tube from the bottle was then hermetically closed at the blowpipe, while the gas was yet passing; the entrance-tube was then hermetically closed, and the bottle placed mouth downwards under water. At the expiration of 118 days no water had penetrated the cork; the bottle was placed mouth downwards under mercury, the end of the shorter tube broken off, and joined to a tube and reservoir filled with mercury, by a piece of india-rubber tube, so that, by turning the tap, mercury was allowed to flow down and gradually fill the bottle from the bottom, and thus displace the gas, through the longer tube penetrating the cork into the gas tubes. On analysis, this gas gave—

Oxygen	0·20	per cent.
Nitrogen, &c. ..	4·74	"
Carbonic dioxide..	95·06	"
	100·00	

The egg, on examination, was found to be decomposed entirely by "putrid cell," and no other germ of decomposition could be found by the microscope. The yolk had expanded and was thoroughly mixed up with the white, and the contents emitted a bad, putrid smell.

To observe whether this "putrid cell ferment" would penetrate the shell, some eggs were placed in water, to which was added the half of the contents of an egg which had been attacked by that ferment. A series of experiments of which this formed part was commenced on August 8th, 1871, in which other lots of eggs were placed in water containing different agents of decomposition; in one or more of the eggs from each of these lots in the series, the "putrid cell" developed, but those immersed in the water containing the "putrid cell" were all attacked by it after 100 days. This ferment, however, does not prevent the development of animalculæ; for within fifteen days from the commencement of the experiment a number of vibrios had made their appearance, besides a large number of animalculæ, which resembled cork-screws, whose bodies were rigid and formed of from one-and-a-half to two turns of the screw; these animalculæ swam quickly about by turning quickly round on the same principle that a cork-screw penetrates a cork. Two more species of animalculæ also developed simultaneously with these screws; they resembled flukes—some possessed one long filament or feeler, and some two, about three times the length of their bodies, and these animalculæ swam about by means of these filaments, which were switched quickly into a serpentine motion before them. It was remarkable, however, that the ordinary vibrios and the putrid cells were the only agents of decomposition which succeeded in penetrating the shells of the eggs and developing within them. The fluke and screw animalculæ never succeeded in making their way through the shell of any egg which came under our observation, although at different times we examined many which lay in fluids swarming with them for months.

I may just mention, *en passant*, that the germs of the screw and fluke before mentioned seem to exist on the outside of the shell, and in no case did we discover their presence among the germs which float in the atmosphere. When the fluke alone takes much part in the decomposition of any albuminous solution, it turns it to a pale green colour and emits an intensely putrid odour, but the screw, on the other hand, emits but little smell.

Decomposition by the agency of Vibrios.—This decomposition is brought about by an animalcule like a worm, which always appears quite straight, sometimes swimming about, and sometimes moving to and fro, or apparently dead. These vibrios are of different sizes, consequent upon their peculiar mode of development, described in one of the papers on protoplasmic life by the late Dr. Crace-Calvert. The long vibrios at first produced divide into two shorter ones, which again sub-divide in the same way, producing four still smaller, and so on till they arrive at the stage of swimming dots, which lastly lose their power of swimming and merely move to and fro. In this state we term them monads, which appear to be the germs of other vibrios, because when they are put into fresh albumen solutions they produce long vibrios, which again follow the same course of sub-division.

These vibrios and their germs exist in large numbers in the atmosphere, so that water or any organic fluid exposed to the air for a few days, especially in summer, becomes contaminated with them, and thus commences a process of putrefaction in organic fluids.

These animalculæ are often found in the contents of w
eggs which are therefore in a more or less advanced st
decomposition; but we have ascertained, by innume
observations, that their germs do not exist in th

originally, but in all cases penetrate the shell from the outside after the egg has been laid.

Whole eggs that remain dry, exposed to the atmosphere for any length or time, are never attacked by this germ of putrefaction; but if the outside of the shell becomes wet or moist, the vibrios floating in the atmosphere fall on it, develop in the moisture on the outside of the shell, then penetrate it, and develop in the contents. In a series of experiments already referred to, we placed six eggs in water alone (completely immersed), and six in water to which had been added some putrid albumen teeming with vibrios; in the former, vibrios had penetrated the shells, and were developing in the contents of the egg within ten days, and in the latter within six days.

I may here refer to another part of this series, where six eggs were immersed in water to which had been added the contents of an egg undergoing putrefaction by the putrid cell ferment. Screw animalculæ were soon developed in this fluid in large numbers, and these much retarded the development of vibrios, which were not found in the eggs contained in this fluid for some time after they had penetrated the shells of those placed in pure water alone, and in those lying in the water containing putrid albumen. It is impossible for the screw animalcule to make its way through the shell into the contents of a whole egg, but they seem to exhaust the fluid of the oxygen it contains, and thus prevent the growth and development of the much smaller vibrio; so that the eggs in this fluid were comparatively fresh when those in the other two fluids above-mentioned were quite putrid. Fluke animalculæ, when they increase in large numbers in any fluid containing vibrios, have also the effect of greatly impairing their vitality. In one experiment, where a drop of a solution containing fluke animalculæ was added to a fluid swarming with vibrios life, the flukes increased in number with remarkable rapidity, and within a fortnight from thirty to fifty could be observed swimming about under each field of the microscope. The vibrios, which at first swam about with much energy, had now lost all power of motion and appeared quite dead, being swept about by the currents produced by the swimming of the much larger flukes.

These vibrios absorb, or breathe in, oxygen, and liberate carbonic acid, and, to show how necessary oxygen is to their subsistence, we took a solution of albumen, prepared by mixing the white of an egg with pure distilled water (distilled in an atmosphere of pure hydrogen); to this solution we added a drop of a fluid swarming with vibrios, mixed it up well, and transferred the fluid to a long tube, with other smaller tubes joined from the side of it, so that part of the fluid could be drawn from the top, middle, and bottom. After this fluid had stood for some days, a little of it was drawn from the top, middle, and bottom of the tube; the top was swarming with vibrios, the middle contained two or three under each field of the microscope, and at the bottom few or none could be observed. We found, further, by enclosing eggs in different atmospheres of gases where the shells of each were kept wet, that carbonic acid gas and coal gas seemed to have a poisonous effect on the vibrio, and prevented any from penetrating the shell; that nitrogen and hydrogen allowed a few to penetrate it, which, however, had little or no vitality, and could evidently not increase in number; whilst in oxygen the contents of the egg was soon attacked by myriads of vibrios, which rendered it completely putrid; and after thirty-five days, the pure oxygen in the bottle at the commencement of the experiment had been much changed, and gave, on analysis—

Carbonic acid gas ..	62·00	per cent.
Oxygen..	34·30	,,
Other gases (principally nitrogen)	3·70	,,
	100·00	

As a comparison with this, another bottle, filled with pure oxygen, contained a dry egg; after the lapse of thirty-five days, the gas in the bottle was analysed, and gave—

Oxygen..	99·46	per cent.
Other gases..	0·54	,,
	100·00	

The egg contained in this gas was quite healthy and free from any germs of putrefaction.

The last experiment which I shall mention of this series is one where the dry egg was pierced by a needle and placed in dry oxygen; here, however, the egg was decomposed by vibrios, and the oxygen largely converted into carbonic dioxide.

Fungus Decomposition.—The fungus which we have found to act principally on eggs, is the *Penicilium glaucum.* The spores of this fungus exist to a large extent, floating about in the atmosphere. If whole eggs be placed in a position subjected to a constant draught, there will be a very small percentage of them attacked by this fungus; but if, on the other hand, they be left in a stagnant atmosphere, the floating spores will soon settle on the shell and begin to develop, sending long fibres or filaments through the shell into the contents. These filaments branch about in immense numbers in all directions, twisting and twining into each other among the contents, so as to become in some cases a dense mass, having the consistency of cheese. In some cases of decomposition by this means we have found the egg to appear as if it had been completely coagulated by cooking; the white appeared to be quite as solid, but more transparent. In some cases, the filaments have not been produced in sufficient quantities to completely coagulate the white into a hard mass, but have crossed from one side of the egg to the other in all directions, and made the white appear like jelly. When eggs are attacked by this means, it is necessary to cut the egg through the middle by a sharp knife to examine its contents, as all sides of the shell are so firmly bound to each other by the filaments, that the whole shell would require to be torn to pieces if the usual method of opening were resorted to.

This spore differs from the vibrio in its being able to penetrate the dry shell of the egg as well as the moist or wet shell. When an egg is attacked by it, its shell is often more or less sparsely coated with a fleece of filaments covered with white spores. These white spores are seldom found within the egg, and they are only produced in presence of a copious supply of air or oxygen. Part of the semi-transparent coagulated mass formed by the filaments of this fungi was cut from the white of an egg, and exposed freely to the atmosphere. Within twenty-four hours a faint white excrescence was observed, which the microscope showed to be a development of spores on the filaments; and in a few days more, the outside of the piece was completely white through the growth of these globular white spores.

In some cases a scanty growth of these filaments with their spores takes place on the outside of the shell, but none penetrate into the contents. In these cases it is remarkable to notice that the shell remains quite smooth; but if, on the other hand, the shell be penetrated by the filaments it feels rough or sandy—produced by the growth of the filaments breaking out little particles of the calcareous matter of the shell.

The growth of this fungi is entirely prevented in an atmosphere of carbonic dioxide. In the gases hydrogen and nitrogen, a few fine filaments of the penicilium were observed to grow from the outside shell, but none penetrated into the contents. In oxygen, however, the growth was most luxuriant in every way.

This fungi acts upon oxygen, converting it into carbonic dioxide; and at the same time it seems to unfold the albumen, liberating nitrogen. This has been shown by several analyses of the gases resulting from keeping eggs for some time in closed atmospheres of oxygen. I shall refer, however, only to one analysis of the gas. A series of experiments were commenced on the 8th of March, 1872; the gases analysed and the eggs examined on the 5th of July, 1872. The atmosphere in the bottle, which at first was ascertained to be pure oxygen, now contained—

Oxygen	48·06	per cent.
Nitrogen and other gases (principally nitrogen) ..	10·15	"
Carbonic dioxide..	41·79	"
	100·00	

The egg on examination was found to be decomposed to a large extent, and by no other agent than the *Penicilium glaucum*.

We ascertained that eggs when pierced by a needle, and laid in a box of loose damp straw, were attacked by this fungi with facility; but many thus left were attacked both by vibrios and fungi, and some were attacked by all three agents of decomposition.

Lastly; having observed that chlorine and chlorides seemed to facilitate the growth of this fungi, we placed an egg in a bottle of common air, and passed into it a little chlorine gas on the 18th of April, 1871. Up till the 12th of December, 1871, no filaments of fungi appeared on the shell. We then opened the bottle, and replaced the cork loosely. On looking at it again on the 19th of December (seven days after opening the bottle) the egg was covered with a thick fleece of white filaments of the fungi, the filaments reaching from 1 to 1½ inches from the shell. This was the most remarkable case of growth of this fungi on the outside shell ever observed by us.

Royal Institution,
Manchester, Sept. 15, 1874.

A FURTHER STUDY OF THE ANILINE DYES.

By S. E. PHILLIPS.

In a study of saffranine relations (Chemical News, vol. xxviii., p. 116), we thought it well to lay some stress on the probability of their being cyano-diamines; nor do we in this parallel effort at all seek to weaken the force of those considerations which are undoubtedly valid and chemically congruous; but, as the subject is far from being a settled one, we make a kindred effort from another point of view. If the first was one-sided—nor did we pretend it to be any other—let this also be understood as a similar glance at synthetic principles which, if more novel, are not the less chemically valid and instructive to observe.

The accepted truth of some future day will, in all probability, include both points of view; but for the moment our concern is only with the latter.

A generic formula has been projected, by which three amides $-6H$ produce one of the condensed and tinctorial tri-amides in question, a kind of nitrile condensation; and, conversely, another has been mooted, by which rosaniline $+2HO$ reverses the process and gives a diamide and H_3N. This diamide $+2HO$ gives a monamide and H_3N; and, finally, another $+2HO$ gives rosolic acid or some such body, eliminating the last atom of ammonia!

Now the generic process involved in this $-2H$ or $2HO$, and its inverse $+2H$ or $2HO$, will be found to cover a very large proportion of organic reactions; and the tendency is *one*, whether it be 2H of a hydride or 2HO of an oxyhydrocarbon.

It is *apropos* to observe that we have pointed out a new feature of this reaction, in the beautiful ammonia glucoside condensations of M. Schiff, where every additional condensation of aniline or ammonia, in the atom, is attended with the elimination of 2HO from the glucoside radical (see Chemical News, vol. xxvii., p. 200).

Æsculetine, $(C_{18}H_5O_6)O+HO$, and aniline $-2HO=$ $(C_{18}H_5O_6)PhHN$.
" " " and 2 aniline $-4HO=$ $(C_{18}H_3O_4)Ph_2H_3N_2$.
" " " and 3 aniline $-6HO=$ $(C_{18}H_1O_2)Ph_3H_5N_3$.

This is only one phase of "*minus* 2HO." In an extended study of urea derivatives, we have found that it very often means a cyano production.

Let An = aniline, $C_{12}H_5\,H_2N$.
" To = toluidine, $(C_{14}H_7)H_2N$.
" Xy = xylidine, $(C_{16}H_9)H_2N$.
" Na = naphthaline, $(C_{20}H_7)H_2N$.

Violaniline, $C_{36}H_{15}N_3=2An+An-6H=(C_{12}H_3)_3H_6N_3$.
Mauvaniline, $C_{38}H_{17}N_3=2An+To-6H=(C_{12}H_3)_2C_{14}H_5H_6N_3$.
Rosaniline, $C_{40}H_{19}N_3=2To+An-6H=(C_{14}H_5)_2(C_{12}H_3)H_6N_3$.
Chrysotoluidine, $C_{42}H_{21}N_3=2To+To-6H=(C_{14}H_5)H_6N_3$.
Magdala, $C_{60}H_{21}N_3=2Na+Na-6H=(C_{20}H_5)_3H_6N_3$.
Xylidine red, $C_{44}H_{23}N_3=2Xy+An-6H=(C_{16}H_7)_2(C_{12}H_3)H_6N_3$.
Another red, $C_{52}H_{19}N_3=2Na+An-6H=(C_{20}H_5)_2(C_{12}H_3)H_6N_3$.
Perkin's red, $C_{40}H_{15}N_3=2Na+H_3N-6H=(C_{20}H_5)(C_{20}H_3)H_7N_3$.
Leucaniline, $C_{40}H_{21}N_3=2TO+An-4HO=(C_{14}H_5)_2(C_{12}H_5)H_6N_3$.
Chrysaniline, $C_{40}H_{17}N_3=2To+An-8HO=(C_{14}H_3)_2(C_{12}H_5)H_6N_3$.

The great difficulty herein is the tardy recognition among modern chemists of the nitrile radicals with diminished ratios of H, and this is the more surprising as they deal so largely with ethylens and other nitrile hydrocarbons of diatomic or triatomic properties, of whose existence there is probably no evidence whatever extant.

As ethyl $-2H$ gives (C_4H_3), and that by a similar action gives (C_4H_1), so the higher ratios of carbon give their corresponding nitrile or other radicals.

In chelidonic acid we have long recognised the ratio of $C_{14}H_1$. In succinic and tartaric acids we have the ratio of C_8H_3 and fumaric C_8H_1. Cernenic acid is $(C_{12}H_1O_6)O+3HO$, and phthalic acid $(C_{16}H_3O_4)O+3HO$.

In sundry so-called mellitic derivatives we have several cases of $C_{18}H_1$ or $C_{18}H_3$, and $C_{20}H_1$ or $C_{20}H_3$, &c. In all such cases there is, doubtless, a strong tendency to evince oxy-ratios, but these are matters of varied degree, and the simple hydrocarbon radicals do most undoubtedly exist under extreme reactions.

Aldehyde, by long digestion with ammonia, gives $(C_4H_3)H_2N-(C_4H_3)_2HN$ and $(C_4H_3)_3N$ and further condensations! I cite these cases as against the many attempts to regard this radical as (C_4H_4) and diatomic.

We have nicotine, $(C_{10}H_5)H_2N$, and Miller speaks of a new base from kreatine, evidently the nitrile $(C_6H_3)H_2N$; and in taking a wide survey of such bodies, and making full allowance for cyano-isomers, there yet remains a very large group, where the normal 2 vol. ammonias, with their well-marked *basic* habitudes, proclaim their distinctive characters.

As we can now distinguish between the isomers $(C_{14}H_7)Me_2N$, or $(C_{16}H_9)MeHN$, or $(C_{18}H_{11})H_2N$, so some future Hofmann will enable us to identify the real character of these tinctorial radicals; but, in the meantime, all these notations are only offered in a *pro tem.* sense, or provisionally.

We say 2 crotonic aldehyde + ammonia $-$ 4HO = aldehydine, $(C_8H_5)_2HN$, but it may be an isomer of the well-known $(C_{16}H_9)H_2N$!

With this *emphatic* proviso, we conclude this notice with a few azo and other kindred bodies where cyano tendencies are undoubtedly paramount and perplexing:—

Azo-naphthaline, $(C_{20}H_5)_2H_4N_2$.
Azo-toluide, $(C_{14}H_5)_2H_4N_2$.
Carbazol, $(C_{12}H_3)(C_{12}H_5)HN$.
Azo-oxybenzide, $(C_{12}H_3)(C_{12}H_3O_2)H_4N_2$.
Diphenine, $(C_{12}H_1)(C_{12}H_3)H_4N_2$.
Azo-benzol, $(C_{12}H_3)_2H_4N_2$.

Hydro-benzol, $(C_{12}H_3)(C_{12}H_5)H_4N_2$.
Ethylen-diamine-sulpho-carbonate, $(CS)_2(C_4H_5)H_3N_2$.
Ethylen-sulpho-carbamide, or ethylen-sulpho-urea, $(CS)_2(C_4H_3)H_3N_2$.
Hydro-sulpho-cyanate of ethylen-diamine, $(CS)_4(C_4H_3)H_7N_4$ (?)
Ethylen-dibenzoyl-diamide, $(C_4H_3)(C_{14}H_5O_2)_2H_3N_2$.
Ethylen-diformyl-diamide, $(C_4H_3)(C_2H_1O_2)_2H_3N_2$.

In the "good time coming" we may hope for more consistency in nomenclature, for simpler names, and clearer types.

In the transition state, we may eclectically regard opposite views, and know that the clash of opinions promotes the acquisition of ultimate truth.

PROPAGATION OF PRESSURE AND FLOW OF WATER IN LONG TUBES.

A lead pipe 3000 metres long and 7 m.m. wide, which M. Oskar Mayer had obtained for some other experiments, afforded a good opportunity for making observations on an extensive scale, on the propagation of pressure and flow of water in cylindrical tubes. The entire length of pipe was made up of 12 rolls, each of 250 metres length. At either end was a force-pump, by which the pipe could be filled with water. The air was allowed to escape through fine holes at the highest point, which were afterwards closed. Further, one end of the pipe was connected with a mercury manometer, the scale of which reached to 5 atmospheres pressure.

"In a first observation, made with this apparatus, I determined the velocity with which pressure was propagated through the entire length of the pipe. According to the principles of the wave theory, it cannot be doubted that the velocity with which a single impulse of pressure is propagated, must be no other than that with which a series of impulses in slow or quick succession is propagated; that is, no other than the velocity of sound.

"The velocity of sound in water (unconfined) is in round numbers, 1400 metres in a second. Wertheim, however, has shown from observation of the tones given by pipes filled with water, that in narrow tubes the velocity is considerably smaller; it only reached 1100 to 1200 metres in his experiments. Considering that in the narrow pipe now used, the motion must be still more retarded through friction, the velocity of sound in it could not be expected to be more than about 1000 metres in a second; so that the entire length of tube would be traversed in 3 seconds.

"This expectation was quite verified in experiment. A sudden pressure of the piston of the pump at one end of the tube produced an effect in the manometer at the other end in exactly 3 seconds.

"In a long series of observations I investigated the laws of the velocity with which water flowed through this long and comparatively narrow tube.

"Of the law governing the flow of water through cylindrical tubes, we have exhaustive knowledge only for the particular case in which the tube is very narrow, a capillary tube, and one of considerable length. This has been studied experimentally by Poiseuille, G. Hagen, H. Jacobson, and others.

"For the case of water-flow through wide tubes, interpolation formulæ have in general been constructed. Only two recent works, one by G. Hagen, the other by C. J. H. Lampe, have aimed at reducing the more complicated laws for wide tubes to the simple form of the law for capillary tubes. Hagen has perfectly succeeded in proving that the same formulæ, through which he represented his own experiments with capillary tubes, also include the law of the measurements made by Darcy on wide tubes.

"With still greater probability might I anticipate a good agreement with Poiseuille's law, in observations with a narrow tube only 7 m.m. diameter. The apparatus was so far altered that the pipe was cut off before one of the force-pumps previously used; the pump at the other end, however, and the manometer beside it being retained. By quick and short motion of the handle of this pump, the mercury in the manometer could be maintained nearly in the same position, while at the other and open end of the pipe, the water flowed out by a regular velocity. The time was observed in which half a litre of water flowed out through the 3000 metres pipe, and this was repeated with varying pressures of the manometer. The temperature of the water was about 96° C.

"Two days later the same experiments were made with shorter portions of the pipe, which was cut through for the purpose. The temperature of the water was 11° C."

The values obtained were utilised for construction of a formula for the flow of water, and they led to the result that Poiseuille's law holds good for outflow of water, not only through capillary tubes, but also through wider, where these are sufficiently long. It was found confirmed for a tube 7 m.m. wide, and 2500 to 3000 metres long. A correction, however, was required.—*Poggendorff's Annalen, Jubelband.*

CRITICAL NOTES UPON THE
ALLEGED NUCLEAR ACTION OF GOLD UPON GOLD REDUCED FROM SOLUTION BY ORGANIC MATTER.*

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

In a paper upon the formation of gold nuggets which appeared in Part I., vol. viii., of the *Transactions and Proceedings of the Royal Society of Victoria*, the author, Mr. C. Wilkinson, states in reference to the question as to the origin of gold nuggets that "Mr. Daintree, formerly of our geological survey (that of Victoria) had on one occasion prepared for photographic use a solution of chloride of gold, leaving in it a small piece of metallic gold undissolved. Accidentally some extraneous substance, supposed to have been a piece of cork, had fallen into the solution, decomposing it, and causing the gold to precipitate, which deposited in the metallic state, as in the electro-plating process, around the small piece of undissolved gold, increasing it in size to two or three times its original dimensions."

The results alleged to have been obtained by Mr. Daintree appearing to have, and indeed being recognised as having, a very important bearing upon the popular question as to how our gold nuggets have been formed, I have endeavoured to obtain further details, but in this I have been unsuccessful. Mr. Brough Smyth, indeed, in his work upon the Gold Fields and Mineral Districts of Victoria, refers to what appears to be the same experiment, but nothing further is there stated except that the size of the gold fragment started with is increased from a "speck" to a "piece." I have therefore tried to reproduce the results themselves, and having been unsuccessful, I will describe minutely the several modes I adopted.

1. 0·1315 gramme of gold, hammered thin, and bent to a curved disc of such a size as to expose about half a square inch of superficies, was placed in a glass vessel containing two ounces of a solution of auric-chloride of a strength equal to half a grain of gold per ounce. For reducing agents small pieces of cork and wood were sunk by glass attachments to the bottom of the vessel in close proximity to the disc of gold.

The vessel was then closed, put in a darkened place, and suffered to remain at rest until all the gold present in solution had been reduced, a process occupying in this case a period of time equal to rather more than two months.

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* Read before the Wellington Philosophical Society.

The gold disc was then carefully examined and weighed. It had a small quantity of very finely granular gold loosely adherent to it, and apparently equally disposed over its surface.

With the whole of this loose gold attached the disc only increased in weight 0·0005 of a gramme, or 1-263rd of its weight (a rate of increase that would require about forty-four years to double the size of the disc), consequently only about the 1-130th part of total amount of gold present in solution had deposited upon the disc, the remainder having deposited away from it, and this was seen to have indiscriminately attached itself to every surface which had contact with the auriferous solution, whether the bottom or sides of the vessel, the glass attachments, or even the surface of the liquid having contact only with the atmosphere.

In reference to the minute quantity deposited upon the gold disc it was found by numerical calculation that the proportion was certainly not more, relatively to the surface of the disc, than that which the remainder of the gold bore to the extent of the surfaces upon which it had affixed itself.

2. The same experiment repeated, but vessel and contents not darkened. Same results as before.

3. Gold solution reduced to half its strength, and time of total deposition extended to four months. Diffused sunlight admitted.

4. Soluble organic matter used in place of wood; sunlight excluded. Time of total deposition of gold two months.

No discernible difference in results upon point in question to those obtained in experiment No. 1.

So far, therefore, as is shown by these results, gold reduced from solution of its chloride by aid of such kinds of organic matter as cork or wood, does not in the manner of its deposition exhibit such a notable selective power for metallic gold as the description of Mr. Daintree's results would lead us to suppose. It does not, indeed, show any such selective process at all, that is, to a greater extent than can be attributed to the action of surfaces generally regardless of their nature; and in support of this, I believe I am correct in stating that the whole sum of our experiences (omitting those of Mr. Daintree) is directly against this theory, as to the rapid and marked deposition of gold on gold in the manner stated; indeed, so far as I am aware, we only produce by these means fine incoherent powder—minute crystals or films of exceeding thinness—nothing nuggety. We get a certain size of grain or crystal, or a certain thickness of film, which our efforts have hitherto failed to enlarge.

Our experience therefore on this point being in such opposition to that of Mr. Daintree quoted above, and which he quiescently allows to be imputed to him, and the subject itself being a most important one, it does seem that the data upon which these apposite statements are founded should be ample, of a definite character, and clearly stated; but so far it does not appear by any means certain, from all I am able to gather on the subject, whether there was in reality any notable deposition of gold on the undissolved residue of gold, and if so, whether the reduction of this gold was solely effected by agency of organic matter. Thus Mr. Wilkinson states, "Accidentally some extraneous substance, supposed to be a piece of cork, had fallen into the solution, decomposing and precipitating the gold." Here then we are led to suppose that the vessel containing the solution, &c., was not closed. What, therefore, might not be reasonably supposed to have fallen in besides cork, or any other kind of organic matter? Pyritous dust, or even a small nugget of this substance, might have accidentally fallen in this solution, splintered off from some specimen which perchance Mr. Daintree himself might have been examining; pyritous matters generally being able, as I have shown, to reduce gold from such solutions, and to deposit it indefinitely upon gold or other electric conductor. Unless precautions had been taken, therefore, to prevent the introduction of reducing agents other than those coming under the description of organic matter, it is impossible to credit the latter with producing the phenomena described. But granting that nothing except organic matter was administered to the solution, even then the evidence as to the enlargement of the "piece of undissolved gold" is exceedingly unsatisfactory.

Thus it appears from the manner of stating the matter that neither the weight nor volume of the "undissolved gold" was determined, the apparatus, &c., evidently not being arranged for any experimental inquiry at all. If then no such determinations were made at the outset, they would be of no value as applied to the piece of gold after the process of decomposition was complete. Consequently the statement that the undissolved gold was increased two or three, or several times, its volume, as Mr. B. Smyth states, is guess-work, for the correctness of which we are dependent upon the power of the eye to realize size, the power of the memory to retain a correct and distinct impression as to the size and shape of the gold piece at the outset, and, further, upon the proper working of the comparative faculty, in order that this image in the memory may be correctly compared with that which the enlarged nugget presented to the eye when the process was finished.

Obviously so many delicate processes are involved in this method of estimating size, that the results given cannot properly be taken as being absolutely correct, nor yet even to have such weight as to induce us to forego our present belief in the dispersion rather than the aggregation of gold precipitating from solution under the circumstances stated.

In the meanwhile, in cognisance of the tendency of gold to scatter when reduced from solution by organic matter, as manifested by my experiment here described, and by our previous experience in this matter, and on the other hand its tendency to agglomerate when reduced from solution by metallic sulphides, I cannot allow Mr. Daintree's results, as at present known to me, to affect me in any speculations I may make as to the origin of gold nuggets in drift.

ON THE PRECIPITATION OF ZINC BY WATER.

By J. L. DAVIES.

Zinc may be added to the list of metals which can be precipitated by means of water. The conditions seem to be these—if to a solution of zinc chloride just sufficient *only* of ammonia be added to re-dissolve the precipitate at first formed, the addition of water throws down zinc in the form of a gelatinous and bulky precipitate. In the cold the whole of the zinc is not thus precipitated, but possibly with continued boiling it might be.

Hafod Isha Works, Swansea.

NOTICES OF BOOKS.

Elements of Metallurgy; a Practical Treatise on the Art of Extracting Metals from their Ores. By J. Arthur Phillips, M. Inst.C.E., F.G.S., F.C.S., &c. London; Charles Griffin and Company.

Metallurgy was an art long before it became a science. By hard-earned experience man acquired considerable skill in the practice of certain metallurgical operations, whilst profoundly ignorant of the principles upon which his operations were based. It is one thing to know empirically how to effect a certain result; it is quite another thing to know rationally why that result is effected. In these days, however, the old method of working by mere rule-of-thumb, has given way in most cases to a more enlightened system, in which the metallurgist gladly seeks the aid of the chemist, and applies the principles of chemical science to the practice of the smelter's art. It is true that no amount of mere scientific knowledge will make a man competent to undertake metallurgical operations; but on the other hand it is equally true that no amount of mere experience at the furnace will enable him to intelligently understand the operations which he daily conducts. The metallurgist needs, indeed, a happy union of practical knowledge with scientific training. Such a combination of experience with theory is fortunately possessed by the author of the work under review, who is consequently fitted in a marked degree for the task to which he has addressed himself in the present volume.

At once an experienced metallurgist and a sound chemist, Mr. Phillips writes upon the smelter's art with the authority of one who has had, in many cases, daily familiarity with the operations he describes; whilst he interprets the meaning of these operations by the light of our most advanced science. Within the compass of a single octavo volume, he leads the student over the whole range of metallurgical science, and judiciously touches upon almost everything that is worth mentioning, whilst avoiding the description of such processes as are either useless or obsolete. Many of the descriptions are based solely on original observation; such for example as that of lead, smelting at Pontagibaud, and of the wet process of copper-extraction so largely applied in this country to the treatment of burnt pyrites. Equally clear descriptions of these and some other processes are not to be found elsewhere.

After an introductory chapter in which the author traces briefly the history of metallurgy, he attacks the main subject of his volume, and commences with a description of the various physical characters of the metals—their colour, opacity, lustre, hardness, specific gravity, crystallisation, malleability, ductility, tenacity, fusibility, conductivity, volatility, and what not. This is followed by a discussion of the characters of the different kinds of fuel—wood, peat, lignite, coal, charcoal, and coke—including a notice of gaseous fuel, which of course introduces us to a description of Siemens's furnaces. Another chapter is devoted to fire-clays and other refractory materials, and their application to the manufacture of crucibles and fire-bricks. Each metal is then described in detail, commencing with iron, as the most important commercially, and continuing the series in the following order:—cobalt, nickel, aluminium, copper, tin, antimony, arsenic, zinc, mercury, bismuth, lead, silver, gold, and platinum. Under the description of each metal we find an account of the ores which yield it, the methods of assaying these ores, and the details of their metallurgical treatment. The processes are described in extremely clear language, and are illustrated by unusually good engravings; in fact, we may point to some of them, such as those of the Ayrsome kiln-hoist, as admirable examples of wood-engraving. The illustrations are mostly drawn to scale, and are, in the majority of cases, taken from original drawings. Particular attention has been paid to the collection of trustworthy statistical information which has been brought as far as possible up to date.

We consider that Mr. Phillips deserves well of the metallurgical interests of this country for having produced a work which is equally valuable to the student as a text-book and to the practical smelter as a standard work of reference.

CORRESPONDENCE.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

Sir,—Can any of your readers explain a statement made by Dr. Voelcker in his annual report to the R. A. Society (*Journal of the Royal Agricultural Society* vol. x., part 1, p. 281), that soluble phosphate can be bought at 3s. 6d. per unit—that is, according to my calculation £7 10s. per ton. I use a large quantity of superphosphate, and always buy it by analysis, and I calculate its value from the rule given by Dr. Anderson in his "Agricultural Chemistry," where soluble phosphate is set down as £30 a ton or 6s. a unit, very nearly twice as much as Dr. Voelcker's estimate. If this latter is correct I have been paying far too much for my manures, and I should be very much obliged for an explanation or by a reference to any book or books that will help me to clear the matter up. Dr. Voelcker, I see, in a paper published ten or twelve years ago, values soluble phosphates at £30 per ton. Has its value decreased lately?—I am, &c.,

A Gloucestershire Farmer.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—The following is a list of minerals of very doubtful character. No minerals bearing these names are to be found in the British Museum. Mineral dealers do not keep them in stock; and yet they persistently keep their places in our mineralogical books. Many of your readers, no doubt, rub up their mineral knowledge occasionally, and find the changing nomenclature sufficiently irritating without the additional nuisance of having to drag year after year this dead log of disgusting old acquaintances, whose sudden death it is not at all sinful to wish. To effect this has been the difficulty. It has struck the writer that if you will kindly assist as executioner by publishing the list of offenders, the deed may be done. These 150 useless dogs have gone unhung long enough. Invite your friends to the *battue*. The books tell us rightly or wrongly their composition. We don't want to be re-told that. The knowledge we want is—whether the things so named exist at all? or if they do exist, by what names are they now called by those who possess them?—I am, &c.

T. A. R.

Liverpool.

Acanthoide
Acnite
Acrusite of *Gerhard*
Alm
Almagierite
Alumina, Native
Amausite
Anchosine
Apatoid
Beaumontite of *Jackson*
Belonite of *Glocker*
Bismuthaurite
Blakeite of *Dana*
Bombite of *Leschenault*
Bottle stone of Moravia
Breadalbanite
Bucaramangite
Caliche of *Thomson*
Caliphite of *Thomson*
Canoxinite of *Bischof*
Calalina stone of Newfoundland
Chionit
Chromochlorit of *Thomson*
Chytophyllite
Claussenite
Clayite of *W. J. Taylor*
Conichrite of *Thomson*
Conistonite
Copper, native sulphide
Copper, pitch-blende
Coulobrasine and Crucite of *Thomson*
Cryptolinite
Culebrite
Cyanolite of *How*
Delarnite
Delawarite of *Lea*
Deliminozite
Dipyrite
Dopplérite of *Deicke*
Dumasite of *Delgre*
Dyripe of *Thomson*
Dyslytite of *Shepard*
Ephesite of *J. L. Smith*
Epiphosphorite of *Breithaupt*
Erusibite of *Shepard*
Erythonium of De Rio
Eschwegite of *Dufrenoy*
Euphotide-Jadien of *Brogniart*
Euphotide of the Alps
Ferrite
Fossil Caoutchouc and Carbon
Gibsonite of *Haidinger*
Grahamite
Granatine of *Hermann*
Halloyvite of St. Jean-de-Cote
Hartine (? Xyloretine)
Heddlite
Helvetan of *R. T. Simmler*
Herrerite of *Herrera*
Hessenbergite of
Hydrocalcite
Dr. Krautz
Hydrohalite
Hydrophillite
Hydrosilicate
Hystatique of *Breithaupt*

Idryl of *Bodeker*
Ioguneitof *Nordenskjold*
Jason of *Jameson*
Kabook of Ceylon
Kalicine of *Pisani*
Kalkoolborthite
Keityoit
Kieselguhr
Kimbleit
Kensigite of *Fischer*
Kir
Klappentein
Konilite
Koodilite and Korcite of *Dufrenoy*
Leedsite of *Thomson*
Leuzinite of *Salvetat*
Leptonemerz of *Breithaupt*
Luscite
Mancinite
Margode
Mariatite
Melardheim
Melaxoite
Melinite of *Glocker*
Melosark
Metaxorite
Molybdanuran
Mourolite
Nepaulite
Nickelthoneisenzinksilicat
Nitramite
Nitromagnesite
Oriental Garnet
Oro Pudre
Pacos
Palladium Ochre
Peucalite of *Thomson*
Phyllin Glance
Pierre de Marmarosch of *Klaproth*
Polyhalite de Vie
Prasochrom of *Landerer*
Protherite
Pyromeline of *Kobell*
Pyrophane
Regikite
Richmondite of *Kenngott*
Röesmerite
Schlaken
Schreiberite
Scoritite
Scotine
Selenpalladite
Serpentinite
Sexangulites of *Breithaupt*
Siderographite
Siderorbole
Silbeloit
Skorilite
Sommait of *Breithaupt*
Sphenomatite
Steatoid
Steel Cobalt
Stephensonite
Stibilite
Stibite
Timagite
Trichite of *Zirkel*
Uigite of *Heddle*
Verrucite of *Apjohn*
Vignite of *Watts*
Warthite
Xerasite
Xylocryptite
Zamtite
Zavalite
Zoïdon

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 6, August 10, 1874.

New Memoir by M. Helmholtz.—M. Bertrand.—A controversial paper in reference to a former essay by the author entitled, "Examination of the Law Proposed by M. Helmholtz to Represent the Action of Two Elements of the Current," and to a recent memoir published by M. Helmholtz in the *Journal fur Reine und Angewandte Mathematik*, of Berlin (Band lxxviii., Heft. 4).

Fifth Note on the Conductivity of Woody Bodies.—Th. du Moncel.—In this lengthy paper the author examines the influence of the direction of the fibres of wood upon its power of conducting electricity.

Researches on Explosive Bodies.—M. Noble and F. A. Abel.

Destruction of the Phylloxera.—M. La Perre de Roo.—The author finds that the water in which flax has been steeped destroys all insects, the phylloxera included, without being injurious to vines.

Application of Gilded Glass in the Construction of the Camera Lucida.—M. G. Govi.—It is known that the construction of the *camera lucida* is founded upon the simultaneous perception of two images—that of the object and that of the pencil. Various means have been employed to arrive at this result. In that of Soemmering it is a metallic mirror smaller than the pupil; that of Amici is constructed on the principle of reflection on a plate with parallel faces; that of Wollaston, at present most in use, consists in a prism, of which the edge, dividing the pupil in two parts, permits the object to be seen by the upper half, and simultaneously the pencil by the lower portion. In all these systems the fusion of the images is somewhat difficult to seize, especially for certain points of the reflected image. Govi, professor of physics at the Royal University at Rome, proposes to cover with a thin layer of gold the reflecting surface of a prism, and to apply upon this, with Canada balsam, a second prism with like angles. Although this layer of gold is sufficiently transparent to allow the luminous rays to pass, its power of reflection is considerable, and it gives images of great brightness. We have thus a perfect means of superimposing, without fatigue to the eye, two different images—the one direct, and the other reflected. The principle is the application of that property of thin plates—metallic or otherwise—to transmit simultaneously direct rays, and to reflect rays which arrive obliquely from another source.

Stratification of Electric Light.—M. Bidaud.—The author, repeating the experiment with electric light in rarefied air, replaced the tube used for demonstrating the law of the fall of bodies in a vacuum, commonly employed in this case, with a straight Geissler tube with three bulbs, of 0·6 metre in length. One of the platinum wires was connected with the ground by means of a small chain, and that from the other end was brought near the conductor of a Carré's machine. A light was thus obtained as stratified as if the tube had been connected with the wire of a Ruhmkorff's coil. The phenomenon only showed itself when the wire was 1 to 4 centimetres removed from the conductor.

Decolourising Charcoals, and their Artificial Production.—M. Melsens.—The only process which allows of producing artificial decolourising charcoals, approaching in their properties to bone-black, consists in impregnating woody matters with phosphate of lime dissolved in hydrochloric acid. The phosphates are thus distributed as they are in natural bones. The mass thus prepared is ignited. The difficulty consists in obtaining products of a sufficient density and mineral richness, and free from foreign salts. The charcoal obtained has to be washed in excess of water to remove chloride of calcium if poor coprolites have been employed. The author uses the coprolites found in small granules in the grey phosphatic chalk of Ciply.

Constitution of Clays.—M. Th. Schlœsing.—(Second note.) The various silicates of alumina, the mixtures of which constitute clays, have not yet been isolated, as their chemical and physical behaviour offers no differences sufficiently well marked. Levigation does not even enable us to separate clay from fine sand, much less to distinguish the several silicates. Water rendered slightly alkaline enables us to separate the clays which remain suspended, and which may be compared to colloid bodies, from those formed of grosser particles which collect at the bottom of the vessel. It is thus possible to fractionate the deposits, and to analyse the successive lots. The suspension of clay in alkaline water offers another means of analysis hitherto unforeseen. After some days of repose, the clayey liquid separates distinctly into superposed horizontal strata, increasing in opacity from the top to the bottom of the vessel. The formation of these strata can be explained only by the presence of several silicates, classified by gravitation according to an order which depends on the shape, the size, and the density of their particles. In case of a clay which, like certain kaolins, contains only one silicate, only one stratum is seen. Many analyses of kaolins have been published, especially by Brongniart, Malaguti, Ebelmen, and Salvetat. These chemists not being able to remove foreign matters, such as felspar, mica, and quartz sand, by levigation, have had recourse to certain solvents, acid and alkaline, capable of attacking merely the kaolinic clay. The elements of this substance were then sought for in the residues and in the solvents. Such procedures give the gross composition of the clay, but they fail to show whether the sample consists of several silicates or of one only. Agitation discovers in alkaline liquids, holding certain clays in solution, a mirror reflection, varying much in the different kaolins, and due to crystalline particles. On examining certain clays under the microscope we sometimes find minute crystals with well-defined angles.

Determination of Tannin.—MM. A. Muntz and Ramspacher.—A modification or the "raw hide" method. A morsel of hide, softened in water, is stretched over a small drum of zinc, 0·06 metre in diameter, and secured by means of a copper wire. The opposite face of the drum terminates in a tube, to which can be adapted an india-rubber tube, 1·5 to 2 metres in length, and terminating in a funnel. Into this a known quantity of the extract of the sample is poured, so as to fill it. The first 4 or 5 c.c. which run through the skin are rejected. 25 c.c. of the filtrate are evaporated to dryness at 100° C., and the same quantity of the original liquid. The difference is tannin.

An Arrangement for Collecting the Iodine Volatilised during the Manufacture of Superphosphate.—M. P. Thibault.—The presence of iodine in certain mineral phosphates from the deparments of Tarn-et-Garonne, and of Lot, is well known. The author has also found it in the phosphorites of Nassau, and of Cocues, in Estremadura. His arrangement for collecting the iodine consists mainly of a cast metal dolly, which receives continuously the powdered mineral and the acid in constant proportions. The mixture falls into brick chambers, where it becomes solidified. A powerful aspirator draws the acid vapours evolved, and forces them to traverse a sheet-iron column filled with coke moistened with water. The same volume of liquid is passed repeatedly over the coke. It may be brought to contain 8 grms. of iodine per litre in the state of proto-iodide of iron, the metal which forms the apparatus being attacked. In the liquid are also found chloride and fluoride of iron, but not a trace of bromides. The liquid may be treated according to the method of Serullas with a suitable quantity of sulphate of copper. The amount of iodine present in the liquid must be determined by a preliminary assay. A grey powder is thrown down, Cu_2I,HO. This is washed in water, drained, and dried. To extract the iodine it is heated with an excess of oil of vitriol, when the iodine is deposited in the cool parts of the apparatus. The greater portion of the iodine, however, is not volatilised, but remains entangled in the mass.

Etherification of Glycol.—M. Lorin.—The reciprocal action of oxalic acid and of glycol is analogous to that of glycerin. It differs from it, however, in the point that the formines are partly eliminated, and that diformine is found on distilling the formic acid produced. The formines are obtained also by substituting formiate of potash for acetate in the preparation of glycol. The preparation of 'glycol, and of its ethers, may be generalised by the employment of any salt, and of any alcohol along with bibromide of ethylene, and the simultaneous production of the ethers of the mono-atomic alcohols.

Tetra-Terebenthen—a Solid Polymer of the Essence of Turpentine.—M. J. Ribau.—Not adapted for abstraction.

Albumens of White of Egg, with Reference to the "Reclamation" of Arm. Gautier.—M. A. Béchamp.—A controversial paper. (See *Comptes Rendus*, lxxvii., p. 1588.)

Analysis of Specimens of Beef as Sold in the Markets of Paris.—Ch. Mène.—A tabular view both of the ultimate and proximate constituents of the flesh from different portions of the animal.

Liebig's Annalen der Chemie und Pharmacie.

July 3, 1874.

On Meta-Toluydin.—F. Lorenz.—This base was prepared according to the method of Beilstein and Kuhlberg. It is a colourless oil, which on exposure to air grows darker and becomes resinous. Its boiling-point is 197°, and its sp. gr. at 25°=0·998. The following are its characteristic reactions as compared with ortho-toluydin and para-toluydin:—

1. The base, dissolved in bihydrated sulphuric acid, is mixed with chromic acid, previously dissolved in sulphuric acid of the same degree of concentration.

Ortho-Toluydin (*Pseudo-Toluydin*).—Blue colouration, which on dilution with water passes into a permanent violet-red.

Meta-Toluydin.—Yellowish brown colouration, becoming a clear brown if heated; on the addition of a little water it becomes a greenish yellow; more water renders it colourless.

Para-Toluydin.—Yellowish colour.

2. A little nitric acid is added to the solution of the base in bihydrated sulphuric acid.

Ortho-Toluydin (*Pseudo-Toluydin*).—Orange colour; brown if solution is highly concentrated; becomes yellow again on the addition of water.

Meta-Toluydin.—Immediate reddish colouration, rapidly passing through intense blood-red to a dirty dark red; then, on the addition of water, orange colouration.

Para-Toluydin.—Blue streaks, which soon extend, turning the whole liquid deep blue. After one minute the colour becomes violet, then red, and, after a few hours, brown.

3. The base is dissolved in equal measures of ether and water, and a few drops of a clear solution of chloride of lime are added.

Ortho-Toluydin (*Pseudo-Toluydin*).—The aqueous layer turns first yellow and then brown; the ether, decanted and shaken up with a little dilute sulphuric acid, takes a very permanent violet-red colour.

Meta-Toluydin.—The aqueous layer turns a turbid yellowish brown; the ethereal takes a reddish reflection, and if decanted and shaken with an equal volume of water and a drop of dilute sulphuric acid, it shows a faint violet colouration in its lower stratum.

Para-Toluydin.—No reaction.

The paper further contains a description of the acid oxalate of meta-toluydin, $C_7H_9N,C_2H_2O_4$; the sesqui-oxalate, $(C_7H_9N)_3(C_2H_2O_4)_2$; the neutral oxalate; the sulphate, nitrate, and hydrochlorate; metamidortho-sulpho-toluolic acid and its salts: tribrom-meta-toluydin; and meta-toluydin-sulphuric acid and its salts.

Quantitative Determination of Para-Toluydin in Presence of Ortho-Toluydin.—F. Lorenz.—In the *Ann. de Chim. et de Phys.* (1872), xxvi., 249, Rosenstiehl describes a method for this determination, depending on the insolubility, or sparing solubility, of the oxalate of paratoluydin in pure ether. 0·2 grm. of the mixed bases are dissolved in 80 grms. of ether, and a solution of oxalic acid in ether (1·062 grms. acid in 250 c.c. ether) is added from a burette as long as a precipitate is formed. He maintains that the end of the reaction can be easily recognised. Lorenz finds it better to place in the liquid a piece of blue litmus paper, which reddens as soon as all the para-toluydin has been precipitated in the state of oxalate. The determination is still more accurate if to the ethereal solution of the bases oxalic acid be added in known excess. The precipitate is filtered off, and washed with a little ether; the filtrate is evaporated to dryness, the residue dissolved in a little water, and titrated with decinormal soda, with tincture of litmus as indicator. The difference between the amount of oxalic acid thus found and the quantity originally added, gives the quantity which has combined with para-toluydin.

Meta-Brom-Ortho-Sulpho-Toluolic Acid.—Dr. E. Weckwarth.—Not adapted for abstraction.

Ortho-Amido-Para-Sulpho-Toluolic Acid.—Dr. M. Hayduck.—The author describes this acid, its baryta and lead salts; the ortho-brom-para-sulpho-toluolic acid, with its potash, baryta, and lead salts; its chloride and amide; the products yielded on distillation with hydrate of potash, viz., aniline, anthranilic acid; the chloro-toluchinons obtained on treating the amido acid with hydrochloric acid and chlorate of potash; dibrom-ortho-amido-para-sulpho-toluolic acid, obtained by treating the ortho-amido-para-sulpho-toluolic acid with bromine; diazo-ortho-amido-para-sulpho-toluolic acid; ortho-cresol-para-sulphuric acid with its salts; the nitro-diazo compound; nitro-ortho-cresol-para-sulphuric acid; and nitro-ortho-brom-para-sulpho-toluolic acid.

New Nitro-Toluydin.—O. Cumerth.—This compound forms long, pale yellow, crystalline needles, grouped concentrically, sparingly soluble in water, but readily in alcohol. It dissolves in concentrated acids, forming very unstable compounds. Its formula is $C_7H_6(NO_2)NH_2$.

Para-Amido-Ortho-Sulpho-Toluylic Acid.—Dr. F. Jensen.—This acid has the composition—

$$C_7H_6(NH_2)SO_3H,H_2O.$$

It forms hard, colourless, well-developed rhombohedral crystals, but never pale yellow long columns. It does not lose its crystalline water over sulphuric acid, and decomposes at elevated temperatures without fusion. It is sparingly soluble even in warm water, and insoluble in alcohol and ether.

Certain Decompositions of Pyruvic Acid.—Dr. C. Böttinger.—A very long paper, not adapted for abstraction.

Acenaphthen and Naphthalic Acid.—Arno Behr and W. A. van Dorp.—A characteristic of acenaphten is its picric acid compound, which is very permanent, forming orange prisms, and is sparingly soluble in alcohol. The authors describe naphthalic acid and certain of its salts, naphthalimid, naphthal-methylic ether, and acetylen-naphthalin.

Volume Constitution of Solid Bodies.—Dr. H. Schrœder.—The author examines the isosterism of the corresponding seleniates and chromates.

Examination of Coal-Tar Oils more Volatile than Benzol.—K. Helbing.—We shall endeavour to insert this paper *in extenso*.

Examination of a New Fossil Resin.—K. Helbing.—This resin is found sparingly in a stone quarry at Enzenau, between Tölz and Heilbrunn. It has a dark brown colour, a resinous lustre, and a conchoidal fracture. It is faintly translucent on the edges, very friable, and gives a yellowish grey powder. At 300° it is still solid. If heated upon platinum-foil it melts and burns, giving off a pleasant aromatic odour, and leaving a bulky carbonaceous residue. It was found interspersed with iron pyrites in so fine a state of division as only to become visible on elutriation. It was composed of—

Carbon	74·15
Hydrogen	9·53
Oxygen	1·91
Bisulphide of iron	14·41
	100·00

The ash being deducted, its percentage composition is—

Carbon	86·68
Hydrogen	11·24
Oxygen	2·18
	100·00

On treating 10 grms. of the finely-pulverised resin with ether a portion was dissolved. The ethereal solution had a yellowish brown colour, with a green fluorescence; and after evaporation left 2·8 grms. of a brown resinous mass, which became brittle when dried at 100°, and yielded a pale yellow powder. By repeatedly treating with hot alcohol the part soluble in ether a portion was extracted. The portion soluble in ether, but not in alcohol amounts to 19 per cent; the part soluble in both, to 9 per cent; and the residue, insoluble in both, 72 per cent. Bisulphide of carbon, benzol, and chloroform dissolved the two former portions, but had no action on the insoluble residue. The latter portion gave on analysis—

Carbon	73·12
Hydrogen	9·30
Bisulphide of iron	17·10
	99·52

Or deducting the pyrites—

Carbon	88·21
Hydrogen	11·22
	99·43

On Cymols.—F. Fittica.—The author contends that the cymols from camphor, oil of ptychotis, and thymol are identical, and that the propyl which they contain is the normal form.

Constitution of Benzol.—A. Ladenburg.—A hypothetical paper.

Derivatives of Phloretin.—Hugo Schiff.—The compounds spoken of are phloretinic acid, phloroglucin, phloroglucid, and triphloretid. The author has endeavoured to convert certain fatty and aromatic oxycarbon acids into tannic acids by the action of the oxychloride of phosphorus.

Reimann's Farber Zeitung, No. 28, 1874.

This number contains a continuation of the directions for dyeing plushes; receipt for a black on woollen felt; continuation of article on management of vats; production of a fine violet ground on vatted cottons; orange reserve for indigo-blue styles; steam colours for thibets, shawls, &c.; and crimson for woollen and mixed garments.

No. 29, 1874.

This number contains a notice of an aniline ponceau made by Schlumberger, of Brussels, the manufacture of which is not explained. The patent colours of Croissant and Bretonnière are now manufactured on the large scale, and are found useful for browns, greys, and drabs. The water used must be free from lime. Cotton goods after dyeing are raised in a weak boiling bath of bichromate of potash, passed through a dilute boiling solution of soda, washed, and dried. There are receipts for blue-black, green, and bright madder red on wool; conclusion of the treatise on plushes; a receipt for a light blue on cotton yarn; an orange reserve for indigo styles; receipts for a brown, two shades of green, and marine blue on felt hats, and for printing with indigo by the hydrosulphite process.

No. 30, 1874.

Aniline Black for Printing Yarns.—The following colour is recommended fot block work:—

Gum tragacanth water ..	1	litre.
Water	1½	,,
Sublimed aniline black ..	280	grms.
Chlorate of potash	80	,,
Water	1½	litres.

The "sublimed aniline black" is only prepared by Schlumberger, of Brussels. After printing, dry and age for forty-eight hours at 30° with a damp atmosphere. As soon as the colour appears of a greenish black wash, and pass through a weak chromate bath, and then through soda. Wash and dry. This number contains a continuation of the paper on fixing indigo by the "hydrosulphite" process; receipts for dark and light greens on linen and cotton; for a pansy, lavender, and prussian blue on cloth.

Gold Lacquer for Leather.—Make a concentrated solution of magenta in an alcoholic solution of shellac.

Dingler's Green.—A mixture of phosphate of chrome and phosphate of lime.

Cœrulignon.—Fischer, on thickening this supposed blue colour with gum, printing, washing, and passing a chrome bath, obtained not a blue but an orange.

No. 31, 1874.

This number contains directions for dyeing Nicholson blue *in rhyme*; a receipt for printing black upon wooller goods for rainbow effects; formulæ for different shades of mode on shoddy; a straw colour on woollen yarn; and a Bismarck brown on felt hats. There is, further, a continuation of the instructions for working the new "hydrosulphite" vat.

Coupier's colour works at Poissy, near Paris, the establishment where the nitro-benzol colours originated, are said to be finally closed.

As a test for dextrin fraudulently introduced into gum-arabic, it is recommended to pour a concentrated solution of ferric chloride upon the mixture. The gum-arabic adheres to the bottom of the vessel, whilst the dextrin remains loose.

The ancient Egyptians are said to have used as ink, soot suspended in a boracic solution of shellac.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 16, 1874.

Numerical Relations Between the Volume of Compound Bodies and the Atomicity of their Elements.—M. Mehay.—If the formula of a carbonated compound body is written under a double volume of that of the quantity of hydrogen taken as an equivalent, it will be observed that the sum of the atomicity of all the elements comprised in this formula is an even number, and that the number of the atomicities of each of the elements which it contains is a multiple of the atomicities of these elements.

Specific Heat of Bodies, and Density of the Ether.—M. Ch. Puschl.—The author points out a connection between the anomalous specific heat of carbon and the anomalies offered by its transparency, with regard to the thermic radiation of bodies at a low temperature. He holds that the *vis viva* of atomic movements in solid bodies is small in proportion to the quantity of rays accumulated by reflection in the ether occupying the interstices between the atoms; bodies are almost absolutely opaque for their internal radiation whilst the temperature does not exceed ordinary limits; the weights of the chemical equivalents of bodies are not relative atomic weights, but rather quantities of weight having an equal atomic surface.

Paper from Mulberry Bark.—The bark of the mulberry tree can, it is said, be easily and cheaply converted into an excellent material for paper.

New Method of Making Pulp for Paper.—V. E. Keejan forces a cold alkaline lye into the pores of the woody fibre of plants by hydraulic pressure. After this a simple washing suffices to obtain the mass in a suitable condition.

Anderson's University.—Professor Dittmar, F.R.S.E., Owen's College, Manchester, has been appointed to the Chair of Scientific Chemistry at Anderson's University. Mr. Dittmar succeeds Dr. Thorpe, F.R.S.E., who is now Professor of Chemistry at the Yorkshire College of Science, Leeds.

NOTES AND QUERIES.

Preparing Crystals of Phosphorus.—W. Douglas Herman (*Chem. Centr.*, 1874, 3) and J. Lawrence Smith (*Dingl. Polyt. Journ.*, ccxi., 402), *Journ. Chem. Soc.* II. series, vol. xii., page 869, give methods for preparing crystals of phosphorus, by exhausting a tube, sealed up at one end, containing a piece of phosphorus, sealing up the other end when exhausted, and allowing it to stand for a few weeks. Two years ago I proposed to try the action of phosphorus on nitrogen gas. I filled a tube, sealed up at one end, with nitrogen gas, placed a piece of phosphorus in it, and sealed up the other end. I then heated it before the fire, melted the phosphorus, and spread it over the sides of the tube, and placed it on one side, thinking of heating it in a water-bath. On looking at it a few days after, I was surprised to find small crystals beginning to form, so I abandoned the idea of heating it any further, but allowed the crystals to form. In about a month beautiful colourless crystals had formed on the sides of the tube. The crystals remained colourless four or five months, and then gradually turned lemon-yellow. At the present time a great number have disappeared, the tube having a small hole in it, caused by the expansion of the gas when sealing up the tube.—George Whewell, F.C.S.

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The FIRST SESSION will commence on Monday, October 26, 1874, and terminates July 23, 1875.

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Textile Industries—Professor William Walker (Endowed by the Clothworkers' Company, London). Fees—Course A, £10 10s. Course B, £5 5s.

The arrangements for Evening Classes will be announced hereafter.

Prospectuses of the Courses of Lectures are now ready, and may be had by written application to the Secretary.

J. D. HEATON, Chairman.
Sept. 24, 1874. HENRY H. SALES, Secretary.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

THE CHEMICAL NEWS.

Vol. XXX. No. 776.

ON ARSENIC FLUORIDE.

By R. W. EMERSON MACIVOR.

Arsenic trifluoride, 'As'''F$_3$, is obtained by the action of sulphuric acid (H$_2$SO$_4$) on an intimate mixture of dry calcium fluoride with anhydrous arsenic trioxide, contained in a small leaden retort. At a low temperature it distils over, and may be collected in a dry glass receiver. The reaction which takes place is represented by the following equation:—

$$3H_2SO_4 + \text{"As'''}_2O_3 + 3Ca''F_2 = 3Ca''SO_4 + 3H_2O + 2\text{"As'''}F_3.$$

Arsenic trifluoride is a colourless, very volatile liquid, emitting dense vapours on exposure to the air, and boiling under the ordinary atmospheric pressure at 63° to 66° C. Its specific gravity is 2·66. It is miscible with alcohol and ether. Water immediately decomposes it, with production of arsenic trioxide and hydrofluoric acid. When perfectly anhydrous, it does not exert any action on glass, but in the presence of a small quantity of water it corrodes that substance. When submitted to the action of a stream of dry ammonia, it absorbs a quantity of the gas, yielding a white, non-crystalline mass, which dissolves in alcohol and ether, but is decomposed by water, with formation of ammonium fluoride and arsenite.

Glasgow.

ON THE ESTIMATION OF FERROUS OXIDE IN SILICATES.

By WILLIAM EARLY,

Demonstrator of Chemistry in Trinity College, Dublin.

The accurate estimation of ferrous oxides in silicates which are insoluble in acids is a task of well-known difficulty, and the methods usually employed are open to obvious objections. The process generally recommended consists in fluxing the powdered silicate with a mixture of potassium and sodium carbonate, or with potassium acid sulphate, and subsequently dissolving the fluxed mass in hydrochloric or sulphuric acids, and titrating with potassium permanganate or bichromate. Now this method is evidently subject to the following sources of error:—(1) During the fluxing, the ferrous oxide will inevitably absorb oxygen from the air; (2) if manganous oxide is present, it is always partially converted into potassium manganate, which, on addition of acid, will oxidise the ferrous salt. The following process, which I have practised with success, is free from the above-mentioned sources of error, and may be recommended for the ease and rapidity of its accomplishment:—

About 2 grms. of the finely-powdered mineral are placed in a deep platinum crucible, and 40 c.c. of hydrofluoric acid (containing about 20 per cent HF) are added. The whole is heated to near the boiling-point, and occasionally stirred with a platinum wire until the disintegration of the silicate is complete, which usually takes place in about ten minutes. 10 c.c. of sulphuric acid diluted with an equal volume of water are now added, and the heat is continued for a few minutes. The crucible and its contents are then quickly cooled, diluted with water which has been freed from oxygen by previous boiling, and the ferrous salt present is estimated by titration with potassium permanganate or bichromate.

It may be remarked that hydrofluoric acid which has been prepared in a leaden vessel invariably contains sulphurous acid. In order to render such acid fit for use, potassium permanganate must be added until the colour exactly ceases to be discharged.

I have lately had occasion to analyse a large number of trap-rocks, and have found that in every case I obtained a far larger percentage of ferrous oxide by dissolving the mineral in hydrofluoric acid, than by fluxing it with sodium and potassium carbonate.

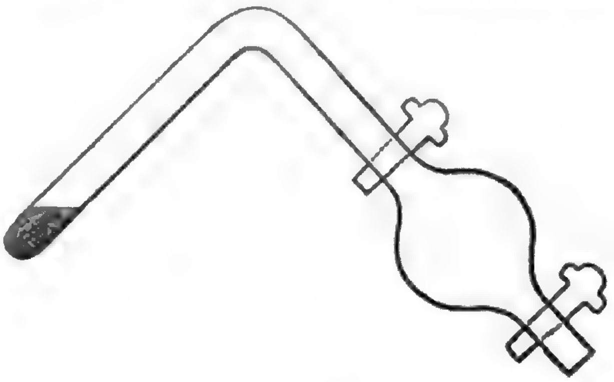
Thus, in the analysis of a trap-rock which contained 1·2 per cent of manganous oxide, I obtained 5·73 per cent of ferrous oxide by solution in hydrofluoric acid, whereas the method of fluxing only yielded 1·3 per cent.

NEW APPARATUS FOR THE CONDENSATION OF AMMONIA AND CHLORINE.

By SERGIUS KERN, St. Petersburg.

For the purpose of condensing ammonia and chlorine, Faraday used a strong, bent, sealed tube. It being necessary to break this tube after every experiment, in order to obtain the condensed gas, I employ an apparatus of the following description, which has this merit, that it will serve for an indefinite number of experiments:—

The apparatus consists of a strong bent tube, as shown; one end being sealed, and the other formed into a sphere having two cocks, one on each side of the sphere. In order to obtain either of these condensed gases, chloride of silver saturated with ammonia, or hydrate of chlorine (Cl10H$_2$O), is introduced into the sealed end of the tube through the cocks. The cocks being then closed, the operation is conducted in the usual manner.



AMOUNT OF CARBONIC ACID IN THE AIR OF CANAL BOATS.

By CHARLES A. CAMERON, M.D.,

Professor of Hygiene, Royal College of Surgeons; Chemical and Sanitary Officer, Corporation of Dublin, &c.

(1). **Cabin**, 183¾ cubic feet; three occupants, each having 61¼ cubic feet. No windows or ventilators, except, for the latter, a hatch, 4 square feet; height of cabin, 3 ft. 9 in.; close iron stove, burning peat. Amount of carbonic acid (8 a.m.), 0·34 per cent.

(2). Cabin, 4ft. 3 in. high, 400 cubic feet; a close iron stove burning peat; three occupants, but two absent the night before examination. Amount of carbonic acid, 0·098.

(3). Cabin, 3½ feet high, 350 cubic feet; stove burning peat. No opening, save hatch of 4 square feet; occupants, two men and a boy. Air, at 7.30 a.m., felt very close. Amount of CO$_2$, 0·365 per cent.

(4). Cabin, 4 ft. 10 in. in height; 360 cubic feet. No ventilators, save hatch of 3 square feet; iron stove, burning peat; three men sleep in one bed, a boy in another, and two dogs on the floor. Air (8 a.m.) felt oppressive. Amount of carbonic acid, 0·95.

The persons sleeping on board canal boats are very liable to phthisis, and other diseases produced or aggravated by breathing vitiated air.

THE NEW DYES OF CROISSANT AND BRETONNIERE.

By ADOLPHE OTT.

The new dyes of Messrs. Croissant and Bretonnière, of Laval (Dept. Mayenne, France), comprise all shades of brown, yellow, and grey; some tints of lilac, greys, and violets, also a colour very nearly approaching black, have thus far been produced. They are not very brilliant when compared with the aniline dyes, but they are of a peculiar warmth of tone, which makes them especially suited for fashion colours (*Modefaerben*). In combination with the wood and extract colours, as well as with the aniline dyes, very beautiful new shades are obtained. Besides, they surpass in durability any dyes known, being not in the least affected by either strong acids or alkalies. The sources from which the new colouring matters are obtained embrace almost all organic substances, amongst which are more particularly mentioned:—Wood, sawdust of all kinds, humus and vegetable detritus, lichens and mosses, bran, farina, gluten, starch, fecula, sugar, glucose, cellulose, paper and cotton waste, tannin, gallic acid, gelatin, casein, fibrin, blood, horn, soot; tartaric, citric, and formic acids and their alkaline salts; resin; aloes, guaiacum, dragon's blood; gum resins, such as gumlac, &c.

The process by which those dyes are produced consists in the treatment of the organic body to be operated upon with certain sulphides at a more or less elevated temperature, according to the nature of the substances under treatment and the tint required. The process of manufacture is exceedingly simple; it requires neither costly nor complicated apparatus, and little labour. According to a calculation of Messrs. Wirth and Co., in Frankfort-on-the-Maine, who are the sole agents for the inventors, the cost of a factory for the production of 100,000 lbs. per year will not exceed £2010, while the net profit appears to be much greater than that reaped in the manufacture of the aniline colours.

The new dyes are generally of a much greater intensity than most natural dyes: they are soluble in water, and, what is very important, especially in calico-printing, they adhere to the fibre without any mordant—still they are mostly fixed by means of bichromate of potash; and finally they are cheaper than any dyes known.

The Société Industrielle de Mulhouse (Alsace) has expressed itself very favourably on these products, and will shortly publish an extensive report. Favourable testimonials were also given by dyers from Lille, Roubaix, Tourcoing, Rouen, Chôlet, and Laval, and for a year and a half the inventors have carried out their process in their own factory, where it can be witnessed. The dyes are known in France as "*Grands Teints.*" I understand that a factory of these new products is already in operation in Göttingen, and that others are to be erected in Breslau and in this city.

Frankfort-on-the-Maine,
Sept. 30, 1874.

CHEMICAL STUDIES OF THE PEPPERS OF COMMERCE.

By A. WYNTER BLYTH, M.R.C.S., L.S.A., A.K.C.;
Analyst to the County of Devon; Medical Officer of Health, &c.

It will be indispensable for some time to come to accumulate facts on the properties of articles of food in the *pure* state. The exact amount of ash, the solubility of substances in different liquids, the specific gravity of the aqueous infusion, &c., many of them, when applied to foods, wholly uninteresting to the ordinary chemist, become of great value in the technical examination [illegible] articles suspected of adulteration. However unimport[illegible] some slight variation in solubility, for example, may [illegible] in a purely chemical sense, yet if that variation be, within certain limits, constant, it is of the greatest utility to the Public Analyst.

The peppers I have examined were obtained from the importers in the berry, and ground by myself; they are, I believe, specimens of pure pepper. The following are the methods adopted in the examination:—

The ash was burnt at a very low temperature in a platinum dish, supporting a chimney to increase the draught; the soluble ash was obtained by boiling the ash with water, filtering, evaporating the soluble ash down in a platinum dish, heating to dull redness, and weighing; the aqueous extract by putting 4 grammes of pepper in a large flask with 500 c.c. of water, distilling over 200 c.c., returning these into the flask, when cool filtering, weighing, and evaporating $\frac{1}{10}$th; the ammonia, by taking 5 c.c. of the last liquid and distilling it with 50 c.c. of alkaline permanganate by Wanklyn's method; and the alcoholic extract, by treating about 1 grm. of the dry pepper with repeated quantities of alcohol, and boiling for some time in a flask connected with a reversed Liebig's condenser. I have not yet estimated the piperine in the peppers; indeed, although it can be extracted with comparative ease, the crystallisation of the alkaloid and the separation of the resin takes up so much time that the process, however satisfactory, cannot be very attractive to analysts, who have to examine a great number of samples in a short time.

Ash.

		Total Ash.	
	Soluble Ash.	Pepper in the Dry State.	Pepper in its Ordinary Condition.
	Per cent.	Per cent.	Per cent.
Penang	2·2120	4·189	3·8480
Tellicherry	3·3800	5·770	5·3460
Sumatra	2·6260	4·316	3·3340
Malabar	3·4530	5·195	4·6740
Trang	2·5380	4·775	4·2110
A white pepper, ground by myself, bought at a retail shop	0·5584	1·120	0·7889
Long pepper	4·4720	8·308	7·1543

The first five peppers give, as the mean of the soluble ash, 2·84 per cent of the dried substance, the two extremes being respectively 3·453 and 2·212. The mean of the total ash of the five peppers is 4·845 per cent, the two extremes being 4·189 and 5·770.

Hygroscopic Moisture.

	Per cent.
Penang	9·531
Tellicherry	12·908
Sumatra	10·103
Malabar	10·548
Trang	11·664
Long pepper	10·778

It is worthy of note that, as the peppers were finely powdered and kept on the water-bath for many hours, besides water, the volatile oil would to a considerable degree be dissipated.

The total loss of weight may be stated generally at 11 per cent.

Alcoholic Extract.

	Grms. per cent of Dry Pepper.
Penang	7·650
Tellicherry	7·836
Sumatra	6·450
Malabar	6·375
Trang	6·300
The white pepper before-mentioned ..	7·650
Long pepper	2·600

The extract was thoroughly dried before weighing; it may be said to be never less than 6 per cent in black and white peppers. The small extract yielded by long pepper is noteworthy.

Aqueous Extract.

	The Dry Substance yields to Water. Per cent.
Penang	18·335
Tellicherry	16·500
Sumatra	17·500
Malabar	20·375
Trang	18·175
Long pepper	16·825

The total ammonia yielded, in the manner before-mentioned, expressed in percentage:—

100 grms. of—

	NH_3.		Nitrogen.
Penang pepper yield to water	0·450	=	0·370
Tellicherry " "	0·450	=	0·370
Sumatra " "	0·375	=	0·310
Malabar " "	0·295	=	0·243
Trang " "	0·325	=	0·300
Long " "	0·175	=	0·144

As 100 parts of piperine contain 4·9 of nitrogen, if the nitrogen be considered as dissolved piperine, the mean of the piperine boiling-water takes up, and when cold retains, of the first five peppers = 0·017. The small yield from long pepper is a great distinguishing mark.

Barnstaple, Sept. 23, 1874.

NOTES UPON ANIMAL CHARCOAL.
THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

By ROBERT FRAZER SMITH, F.C.S.

All chemists usually state the total sulphur in char as calcic sulphate, even when the sample is from an old working stock. When any notice is taken of sulphides they are generally reported as calcium monosulphide. It appears to me that ferrous sulphide is always the sulphur compound present, and not the calcium sulphide. The latter occurs in new char in exceedingly minute quantity. All the calcium sulphides are soluble in acetic acid with evolution of H_2S.

Anhydrous ferrous sulphide is not in the least affected by this acid, but with HCl, however dilute, at once evolves H_2S. The majority of chars when boiled with glacial acetic acid (free from mineral acids) fail to yield the faintest trace of H_2S. If now the residue from the acetic acid be washed and HCl added, H_2S will come off in abundance.

Expt. 1.—A mixture of calcic sulphate and lamp-black, heated in a crucible to a full red heat, on cooling was treated with acetic acid. The whole of the sulphides were decomposed by the acetic acid, and HCl failed to evolve any more H_2S from the residue.

Expt. 2.—Powdered recently prepared iron sulphide was boiled with glacial acetic acid, but no H_2S was liberated. It would therefore appear that the iron, and not the lime compound is what we have to deal with in char.

It is undoubtedly the case that the sulphur is produced in the revivification from calcic sulphate at the expense of the carbon, but the sulphur transfers itself at once to the iron. The following are the amounts of sulphur stated as such in three working stocks from well known and successful sugar refineries in various parts of Britain. The iron is also stated for comparison.

	I.	II.	III.
Sulphur	0·15	0·19	0·27
Iron	0·43	0·24	0·71
Calcic sulphate ..	0·33	0·51	0·17

An attempt was made to find out in which grist of char the most free sulphur (or ferrous sulphide) resided.

A sample gave when divided into these various sizes—

Above 12 meshes per inch = 0·25 sulphur
12 to 16 " " " 0·17 "
16 to 24 " " " 0·16 "
24 to 30 " " " 0·17 "
30 to 40 " " " 0·18 "
40 to 50 " " " 0·19 "
Under 50 " " " 0·17 "

Some continental refiners use caustic soda to remove organic matter from their char previous to burning.

Expt. 3.—1 lb. stock char was boiled with distilled water containing ½ per cent sodium hydrate upon the char taken. After perfect washing and drying the sulphur was estimated.

Total sulphur stated as calcic sulphate—

Char before treatment ..	1·125	per cent.
Char after treatment	0·915	"
Sulphate lost	0·210	

But the sulphate as such amounted to—

Before treatment	0·26	per cent.
After treatment	0·27	"

Consequently the soda attacked the sulphides in preference to the sulphates. A foreign refinery char, in which soda was used, yielded—

Calcic sulphate	1·520
Sulphur	0·012

Ferrous sulphide is quite readily decomposed by alkalies, and all the evil effects known to arise from the presence of an excess of sulphide in char can be much more easily explained by assuming its presence in preference to calcium sulphide. A curious deposit is frequently seen on the inside of the kiln pipes in certain houses, in fact, more or less in all, but when in great abundance is an evidence of excessive heating. The following results express its composition.

	I.	II.
Iron	60·92	57·55
Sulphur	35·77	31·37
Carbon	—	3·10
Sand	0·41	3·30
Tricalcic phosphate and loss	2·90	5·36
	100·00	100·68

Sp. gr. 4·12

The iron and sulphur calculated to per cents are as follows:—

			Pipe Deposit.	
		Theory.	I.	II.
Iron	56	63·64	63	64·73
Sulphur ..	32	36·36	37	35·27
	88	100·00	100	100·00

It is worthy of note that it is extremely rare to find an accidentally formed iron sulphide having so near an approach to the theoretical numbers. There is generally excess either of iron or sulphur. This deposit is not formed at the expense of the iron of the pipes. These remain *apparently* unchanged. The sulphur and iron have both been undoubtedly derived from the char itself. I propose shortly to show the changes which take place in iron heated constantly in contact with phosphates, and discuss the alleged occurrence of phosphides in char. My thanks are due to my assistant, Mr. John Macdonald, for his help with certain of these and also some succeeding analyses.

Greenock, Sept. 28, 1874.

ON THE FORMATION OF GOLD NUGGETS IN DRIFT.[*]

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

THE manner in which those gold nuggets have been formed which are found in our drift or fluviatile deposits has long been a subject of profound interest. Our Victorian friends in particular have been greatly exercised with this matter, no doubt from having it so frequently and forcibly presented to them by the almost regular announcement from time to time of the discovery of nuggets so large as to be entitled to description in the annals of their gold fields, and to names to identify them by.

From the circumstance of their attention being thus given to this subject, many valuable observations have been recorded by them, and published in the periodicals or other works emanating from their colony.

The first theory broached to account for the presence of these nuggets in drifts was that they had been broken off some rich reef, and transported by water bodily to the positions in which they are now found by us. At first sight this appears very plausible, but there are several considerations which, when allowed to have their due weight, rather tend to shake our belief in its competency to explain the case. These considerations have been discussed pretty freely in the works alluded to, so I need not detail them here, but will only state that, briefly put, the chief of them are as follows:—The large size of many of these nuggets, as compared with any of the masses of gold yet found in our reefs; their position in the drifts, lying sometimes as they do in the upper layers; and their superior fineness of quality as compared with that of any of the reef gold found in their vicinity.

Impressed by these facts, Mr. A. C. Selwyn proposed another theory for explaining the origin of these nuggets, and one which certainly appears to meet the question upon the particular points just cited. This theory is, "that nuggets may be formed and that particles of gold may increase in size through the deposition of gold from the meteoric waters percolating the drifts, which water, during the time of our extensive basaltic eruptions, must have been of a thermal, and probably of a highly saline character, favourable to their carrying gold in solution."[†]

At the time this idea was broached, nothing systematic or thorough had been undertaken towards investigating this matter, as to the probable presence of gold in those meteoric or saline waters referred to, and nothing whatever had been accomplished towards showing any likely means by which gold, depositing from such solutions, would be determined upon itself as a continuous coating, and in such quantity as occasionally to form nuggets of the enormous size we find them in such drifts, nor did Mr. Selwyn indeed make any suggestion on this matter; perhaps, considering the initiation of such an idea sufficient for his part, he left the support of it to the ingenuity of chemists, to whom, in fact, such a labour rightfully belonged; in reality, so little was known in support of this theory at the time of its evolution that it seemed in the highest degree chimerical. Since then, however, chemical investigations have given us results greatly in favour of this idea. Thus, in the first place, as regards the presence of gold in a soluble state in the waters percolating our drifts, it appears that Mr. Daintree found gold in pyrites which had obviously replaced the organic structure of a tree occurring in a drift-bed, and Mr. Newbery, Analyst to the Geological Survey of Victoria, afterwards obtained the same results upon other pyrites occurring in a similar manner, both results showing that gold must have been "presented to the pyrites in a soluble form."

Since that time gold has been by no means unfrequently discovered to be present in certain mineral and mine waters, and indeed Mr. Daintree has recently found gold while testing the water of a mine in Victoria.

Perhaps, though, the most important communication we have relative to this subject is that of E. Sonstadt, "On the Presence of Gold in Sea-Water" (CHEMICAL NEWS, vol. xxvi., p. 159). This metal has, indeed, before this been alleged to exist in sea-water, but these allegations have not been sustained with such evidence, and accompanied with such detailed description of processes employed, as entitled them to an unreserved belief on our part. Sonstadt's experiments, on the other hand, are detailed minutely, and his statements are supported by the results of different processes.

The amount of gold present in the water taken from Ramsey Bay he states to be very minute, "less than one grain in the ton;" still the fact of its presence at all in such water is exceedingly interesting, as showing an escape of gold from the land seaward, and so confirms the correctness of the various allegations I have referred to respecting the auriferous character of certain of our springs and mine-waters.

Thus, in different ways, the first question involved in this theory of Mr. Selwyn is answered in a most satisfactory manner.

As to the means by which the gold present in these waters has been reduced therefrom, and aggregated in masses, solid, homogeneous, and occasionally of considerable size, we have no lack of substances certain to be present in these drifts, and capable of effecting the reduction of gold and silver from the kind of solutions likely to be present there. In various kinds of organic matter, and in sulphate of iron, we have substances which will effect this with facility, but we have no sure evidence as yet to show that either of these substances will aggregate the gold, while they reduce, or locate it, in a marked manner, or preferentially, upon the gold already reduced.

That gold will be reduced by these substances is certain, but all our present experience in regard to the deposition of gold by them shows that gold so reduced will be dispersed rather than aggregated, so that it would appear that nuggets of gold could not well be formed in this manner.

In our mineral sulphurets, however, we have agents which are not only capable of reducing gold and silver from solution, but, besides, are capable of locating them when so reduced in coherent and bulky masses.

I may state that their nuclear action upon gold depositing from solution by aid of organic matter was suggested by Mr. Charles Wilkinson,[*] while their competency to reduce the gold from solution without addition of organic matter was shown by me in vol. iii. of our *Transactions*, pp. 227-230; thus the aggregation of the nuggetty forms of gold from solution becomes a still more simple matter, only one reagent being necessary, so that there is a greater probability of such depositions obtaining than were a double process necessary.

Knowing the action of sulphides, the manner of the mode of formation of a portion at least of these nuggets seems apparent. Conceive a stream or river fed by springs rising in a country intersected by auriferous reefs, and consequently in this case carrying gold in solution; the drift of such a country must be to a greater or lesser extent pyritous, so that the *debris* forming the beds of these streams or rivers will certainly contain nodules of such matters disseminated, or even topping them in actual contact with the flow of water.

It follows, then, from what has been previously affirmed, that there will be a reduction of gold by these nodules, and that the metal thus reduced will be firmly attached to them, at first in minute spangles isolated from each other, but afterwards accumulating and connecting in a gradual manner at that point of the pyritous mass most subject to the current, until a continuous film of some size appears; this being formed, the pyrites and gold is to a certain extent polarised, the film or irregular, but connected, mass of gold forming the negative, and the pyrites the positive, end of a voltaic pair; and so, according as the polarisation is advanced to completion, the further deposition of gold is changed in its manner from an indiscriminate to an orderly and selective deposition concentrated upon the negative or gold plate.

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[*] Read before the Wellington Philosophical Society.

[†] *Trans. and Proc. Roy. Soc. of Victoria*, vol. ix., p. 53.

[*] *Trans. Roy. Soc. Vict.*, vol. viii., Art. II.

The deposition of gold being thus controlled, its loss by dispersion or from the crumbling away of the sustaining pyrites is nearly or quite prevented—a conservative effect, which we could scarcely expect to obtain if organic matter were the reducing agent.

Meanwhile there is a gradual wasting away of the pyrites, or positive pole, its sulphur being oxidised to sulphuric acid, and its iron to sesquioxide of iron or hæmatite, a substance very generally associated with gold nuggets. According to the original size of the pyritous mass, the protection it receives from the action of oxidising substances other than gold, the strength of the gold solution, length of exposure to it, and rate of supply (velocity of stream), will be the size of the gold nugget.

As to the size of a pyritous mass necessary to produce in this manner a large nugget, it is by no means considerable. A mass of common pyrites (bisulphide of iron) weighing only about 12 lbs. being competent for the construction of the famous "Welcome nugget," an Australian find, having weight equal to 152 lbs. avoirdupois.

Such masses of pyrites are by no means uncommon in our drifts or the beds of our mountain streams. The general velocity of the current flowing over such pyritous matters would in all probability be such as would prevent the development of any crystalline form in the gold thus deposited, as we know very well that for such development motion is unfavourable. The form most likely to be assumed by these deposits then would be the mamillary, precisely that in which our nuggets as a rule occur.

Upon this mode of accounting for the presence of large nuggets in our drifts, their occasional great superiority in point of size to any auriferous mass as yet found in our reefs, and their superior fineness to such reef gold, admits of easy explanation.

First, as regards their comparative size, if we only admit that reef gold is also deposited by pyrites, as I attempted to show in the paper just alluded to, and if we assume that the strength of the gold solutions forming these varieties of gold respectively was not greatly different, it is only reasonable to suppose that the gold masses formed in this manner in drift would attain the greatest dimensions, for in the first place this gold in depositing would certainly aggregate more as the pyrites in the drifts or the river beds would be less continuous and more sparsely distributed than that in reefs.

Further, the supply of gold to pyrites lying in these drifts or river beds (and so exposed to rapidly changing waters) would be far more copious than to pyrites cooped up in a rocky fissure, and so in contact only with water stagnant or nearly so.

And, secondly, as regards the generally superior quality of these nuggets to gold found in the reef, it will, I think, appear from the following considerations that such a difference in favour of drift gold is to be expected.

I have previously shown* that silver is deposited with greatest rapidity and certainty upon pyrites from solutions which are alkaline from presence of the fixed alkalies or alkaline earths, and that, as such solutions are passed from this condition to an acid one, the silver present in them is retained in solution; any gold, however, that may be mixed with such silver is deposited upon this reducing agent, no matter which of these conditions the solvent is in.

Now this alkaline condition is precisely that in which, as far as we can ascertain, our lodes or rocks must have been at the time of the deposition of the gold and silver now found in them, and this alkalinity would especially manifest itself in those reefs which traverse rocks of a basic nature, such as diorites or serpentines; hence, by the way, the large proportion of silver alloying the gold found in these reefs, as compared with that alloying the gold found in the lodes of our schists or older formations.

But, though the waters percolating our reefs must be to a more or less extent of an alkaline nature, the drainage waters issuing from them will lose a portion of this alkalinity as they are exposed to the air, or to the products of decomposing organic matters, from having absorbed a quantity of carbonic or other acids (sulphuric, humic, &c.); thus in some measure, according to the distance such waters have travelled from their springs, will their condition be changed until their alkalinity may give way to neutrality, or even acidity, either of which conditions are, as I have stated, unfavourable to the liberal deposition of silver along with gold from such waters. Hence it is apparent that, from the instant the waters percolating rocks or lodes leave them to form springs, &c., they are continually passing from a favourable condition to one eminently unfavourable for the deposition upon pyrites of what silver they may contain. Consequently, the deposition of gold from solution being, as we know, unaffected, or but slightly so (comparatively), by the condition of the solvent, the great purity of gold deposited from these surface waters is explained.

The above explanation of the greater purity of our alluvial or drift gold over gold found in the reef is, I think, much more plausible than that which attributes this difference to the interaction of solutions of gold upon the auriferous masses transported from the reef, whereby the silver of these masses is replaced by gold and so removed, leaving the mass correspondingly richer in gold. That this process can be continued until our largest auriferous masses can be thus affected throughout appears to me impossible when we consider the imperviousness of such metallic masses to liquids, and how nearly the atomic volumes of gold and silver approximate. That a superficial change, however, in this direction may occur is by no means improbable, but such would escape detection unless it were especially sought for. Thus the hypothesis advanced by Mr. Selwyn, as to the manner in which the nuggets of our drifts may have been formed, receives support upon all those points which appear of any importance.

That nuggets of some size may, however, be in a few instances transported bodily from these matrices into the drifts or water-courses is by no means improbable, but in this case they would, I think, partake of the usual quality of the reef gold of the country about, and so would be inferior in this respect to gold formed in the manner above described.

Whatever may be the origin, however, of any particular nugget, or of nuggets generally, when we consider the auriferous nature of many mine waters, also that of sea-water, together with decomposing and aggregating action of metallic sulphurets upon the gold of these waters, we cannot avoid the conclusion that gold is now being deposited and aggregated in many of our drifts, and that such depositions have been going on from remotest times.

In conclusion, the questions as to the source of the gold of our nuggets, the nature of the agencies by which it is dissolved, and the precise chemical state in which it exists in our auriferous waters, are subjects which it is not incumbent upon me to discuss here. I will, however, take leave to make a few observations upon them now.

As regards their source I think this is rather in gold as desseminated in certain of our slate, sandstone, or schist rocks, than in that of our reefs.

In reference to the nature of the solvent, I have shown* that sulphuretted hydrogen attacks gold at ordinary temperatures, forming a sulphide of the metal, and we know that all the sulphides of this metal we have to this time formed are soluble in alkaline sulphides; therefore, as both these agents are generally present in waters situated at some depth in our rocks, we may very reasonably suppose that a portion, if not all, of our gold has been brought into olution by these agents.

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* Trans. N. Z. Inst., vol. iii., Art. XL.

* Trans. N.Z. Inst., vol. iii., Art. XXX.

The state to which such auriferous solutions might pass when exposed to air and carbonic acid is not easy to determine, but of this we may be certain, that it could not well be one unfavourable to the exercise of the reducing properties of metallic sulphurets upon the gold compound present in them.

NOTICES OF BOOKS.

On the Right Use of Disinfectants. By H. Letheby, M.B., M.A., &c. London: Statham and Co.

The substance of this pamphlet was originally read at a meeting of the Society of Medical Officers of Health, and has since appeared in our contemporary, *Public Health.* The author's expressed object, "to remove the many dangerous fallacies which beset the subject, and to arrest, if possible, the unblushing quackery which disgraces it," demands our heartiest approval. It is unfortunate that great public questions, such as the treatment of sewage and town-refuse of all kinds, the disinfection of hospitals, &c., attract the attention not merely of scientific men, but of "pushing" traders, who seize the opportunity for doing a good stroke of business at the general expense. Public ignorance may be called the demand to which quackery stands in the relation of supply, and on few subjects is such ignorance denser than on the nature and action of the substances classed together as disinfectants. We find instances of oxidizing and deoxidizing agents being used together, and of non-volatile bodies, like chloride of zinc and chloralum, being applied to disinfect the air. Dr. Letheby describes the best-known disinfectants under these heads—Mineral acids, organic acids, alkalies, haloids, mineral sulphates, permanganates, volatile oils, charcoal, dry earth, and other porous matters, air and water, and heat. Plain instructions are given concerning the properties of these disinfectants, their mode of application, and the circumstances to which each is adapted. Dr. Letheby, in accordance with the results obtained by Dr. Dougall, ranks the picric and benzoic acids as far more efficient than the carbolic and cresylic. It must, however, be remembered that picric acid is not volatile at common temperatures, and cannot, therefore, be applied for disinfecting the air of a sick-chamber, whilst the high price of benzoic acid must always be a bar to its common use.

We can scarcely agree with the author in his condemnation of solutions of deliquescent salts for watering the streets. We conceive it quite possible to apply them so as to keep the surface of a street or road damp, without becoming, as under the present system of watering, "slimy and slippery." Dust, instead of being blown about, would more likely be prevented. It would, indeed, be difficult to make a change in this respect which would not be for the better, especially in those parts of London where the streets are macadamised. The reader is reminded that we have no trustworthy evidence of the power of the permanganates to destroy contagion. To hang up a sheet, steeped with a solution of a permanganate, in a sick chamber is a total mistake. The permanganate will act upon the sheet, and upon particles of dust composed of dead organic matter much more readily than upon living spores or germs.

We recommend this book to the careful perusal of vestrymen, guardians of the poor, town councillors, and, indeed, of heads of families.

The Phosphates of Commerce; their Composition and Chemistry. By George Jones, F.C.S. London: H. K. Lewis.

The author "having frequently heard the remark made by dealers in the important mineral known in the market by the general term phosphate, that it would be advisable if some well-known agricultural chemist would write an account of its composition and chemistry," has undertaken the task. Accordingly, he gives a general description of phosphates, phosphorites, and coprolites, which he informs us are "the fossil dung and bone of the huge mammal fish the ichthyosaurus." He then gives a brief account of the elements occurring in mineral phosphates. Next follows an account of the hydrometer, a notice of the combining proportions of the elements with which buyers and sellers of manures are chiefly concerned, and some useful remarks on sampling. An appendix gives the average composition of bone-ash, of Spanish phosphate, apatite, Sombrero-phosphate, animal charcoal, Nassau phosphate, Peruvian guano (in which we note the decline in the quality of that substance since its first introduction into commerce), a fish-manure, containing only 3·61 per cent of nitrogen, and a table of the mineral constituents of cereals. The author, in our opinion very judiciously, does not teach farmers and manure-merchants to become their own analytical chemists, an undertaking as impracticable as to render them capable of acting as their own lawyers, physicians, or engineers. Tables are given for calculating the money value of manures from the analysis, in which, however, no value is assigned to potash, although the author declares that carbonate of potash, and epsoms ought to form constituents of all artificial manures. There are also instructions for finding the amount of chamber-acid needed for dissolving phosphates in the manufacture of artificial manures. Notwithstanding certain inaccuracies, we consider that the work will be of service in enabling the agricultural chemist and his clients to understand each other the better.

Oratoric Verse on the Chemical Elements. By J. Carrington Sellars, F.C.S. Birkenhead: J. C. Sellars.

This pamphlet consists of specimen pages of the second edition of a work which appeared some time ago under the title "Chemistianity." Its object is to give an account of the elements in verse, the author believing that a knowledge of chemical facts may be thus most readily acquired and retained.

Butter; its Analysis and Adulterations, specially treating on the Detection and Estimation of Foreign Fats. By A. Angell and Otto Hehner. London: Wyman and Sons.

The authors undertake to give what has been hitherto a desideratum, a chemical method for detecting and determining foreign fats used in the adulteration of butter. They conclude from their experiments that the volatile acids, instead of forming merely 2 per cent of the whole, as given by Bromeis in his analysis, amount to nearly 10 per cent. Their method is as follows:—Butter is repeatedly washed with hot water, dried and saponified in a flask with caustic potash till a clear transparent soap is obtained, which is effected in about four hours. The soap is then decomposed with dilute sulphuric acid, the liquid heated till the fatty acids floating on the top are just fused to a clear oily fluid, and then cooled again. The filtrate is distilled, and the acidity of the distillate estimated by means of a standard soda-solution, and calculated as butyric acid, $C_4H_8O_2$. Supposing the method correct, it is obvious that the addition to butter of any fat containing no volatile acids, such as suet, dripping, &c., will proportionately reduce the amount of butyric acid present in the distillate.

The value of the method turns, then, upon this point—Does the acid distillate consist of butyric acid, uncontaminated with any other body capable of saturating the soda solution? The authors have not performed, or at least have not described, any experiments to decide this question. They tell us that "the distillate never ceases to be slightly acid, and becomes strongly so when so great a concentration has been reached that the glycerin in the liquid begins to decompose. To fill up with water is of no use, since no trace of acid distils over until the original concentration is re-obtained." Is it not possible that acrylic, acetic, and sulphurous acids may be present in greater or less quantity? We hope that the authors will bestow upon this matter a searching investigation.

Handbook of Natural Philosophy. By Dionysius Lardner. (Hydrostatics and Pneumatics). New Edition, Edited by Benjamin Lœwy. London: Lockwood and Co.

Dr. Dionysius Lardner—or "Diabolus Gander," as he is wickedly called in "Ten Thousand a Year"—though of very little merit in the sphere of original research, was an able and judicious compiler. His "Handbook of Natural Philosophy" has done good service, and we are not surprised at the appearance of a fresh edition like the present brought up to the standard of the day. The original work has been divided into five distinct treatises, of which the volume before us—to a great extent re-written by the editor—forms the second. For those "who desire to attain an accurate knowledge of physical science without the profound methods of methematical investigation" this work is not merely intended, but well adapted. There are certain authors who instead of using mathematics as an instrument of research, invert the matter, and appear to treat physical and even chemical truths as mere pegs upon which to suspend a maximum of mathematical formulæ.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 7, August 17, 1874.

Report on a Memoir of M. P. A. Favre on the Equivalence and the Transformation of Chemical Forces.—The author begins by calling to mind that in 1853 he solved the following question:—Is the heat developed by the resistance to the passage of electricity in the conductors of a voltaic pair derived from the total heat which corresponds to the chemical action producing the current? He has established that the heat confined in the liquid of the pair, and that which springs from the resistance of the metallic circuit, are always complementary, furnishing the total heat due to the sum of chemical action, as Joule had already laid down by a kind of intuition. Rigorous experiments were, however, still wanting, and this proof has been furnished by Favre by means of his mercurial calorimeter, in which the battery was inserted. The author next examines the part of the various chemical actions which intervene in producing the calorific effects of a galvanic pair. He is thus enabled to check a view of Faraday's, which facts hitherto had not contradicted, *i.e.*, that the oxidation alone of the metal in a zinc-platinum pair develops the current, and that the solution of the oxide formed in the acid, plays no part. He has established, on the contrary, that the mere oxidation of the zinc does not suffice to account for the effects produced by the current, and that the heat of combination of the acid with the oxide of zinc must also be taken into consideration. From this memoir, the starting-point of the author's numerous ulterior researches, may be derived the correlation and equivalence of chemical duty, and of electro-dynamical duty, in accordance with the views of Joule, Mayer, Clausius, and Thompson. In a second memoir the author extends the conclusions of his first researches to an entire voltaic battery.

Manure for Vines Attacked by the Phylloxera.—Ch. Juge.—The mixture consists of—

Sulphate of ammonia	600 kilos.
Phosphate of lime (precipitated)	200 ,,
Lime	1200 ,,
Alkaline sulphates (2 parts) mixed with chloride of potassium (1 part)	300 ,,
Littery dung	15000 ,,
Or rags	2000 ,,

The dung is previously prepared by being spread out in layers, and each layer is sprinkled with sulphate of iron and precipitated phosphate of lime, and watered with the drainings of the dunghill. Between the vines holes are dug, 40 centimetres deep, 60 long, and 30 wide. At the bottom is placed the prepared dung, then the sulphate of ammonia, and then the alkaline salts. What is to be done with the lime the author does not state. This system has been very successful at Amilhac, near Bégiers.

General Procedure for the Analysis of the Elliptical Rays.—M. Croullebois.—A mathematical paper.

Use of the "Aërian Helix" as a means of Measuring the Intensity of Voltaic Currents, and the Mechanical Power of Electro-Magnetic Machines.—W. de Fonvielle.—A short note accompanying a model exhibited before the Academy.

Constitution of Clays and Kaolins.—Th. Schlœsing.—Analyses of the different parts of clays, as separated by levigation in alkaline water. The author finds that the particles of the plastic clays are in a more finely-divided state than those of the kaolins.

Certain Bismuthic Minerals from Meymac (Corrèze).—A. Carnot.—Native bismuth occurs in brittle irregular nodules, of a crystalline fracture, lamellar, white, and very bright. After exposure to the air it takes a reddish shade. It contains—

Bismuth	99·00
Lead	0·41
Iron	0·10
Antimony	0·15
Arsenic	0·09
Sulphur	0·06
	99·81

Oxide of bismuth is found enveloping the specimens of native bismuth. It is generally slightly hydrated and carbonated, and has the sp. gr. 9·22. It is opaque, semi-vitreous, and of a conchoidal fracture. Its colour is a pale yellowish green, brown in places. It is easily pulverised. In hydrochloric acid it dissolves with effervescence. It melts before the blowpipe, and easily yields a metallic bead upon charcoal. Its composition is—

Oxide of bismuth	96·70
Oxide of lead	0·55
Oxide of iron	0·16
Sulphuric acid	0·15
Arsenic acid	0·13
Antimonic acid	0·22
Hydrochloric acid	0·20
Carbonic acid	0·68
Water	0·95
	92·74

This mineral resembles the tetra-dymite of Virginia, and the variety found in the Fichtelzebirge, and analysed by Suckow. It differs decidedly from the "bismuth ochre" of Lampadius.

Bismuthic Mispickel.—The external characters of this mineral are nearly the same as those of ordinary mispickel. The white fracture often takes a light rose tint on exposure to the air, and the presence of cobalt may be detected by the blowpipe. Three samples have been analysed:—

	I.	II.	III.
Iron	31·90	30·21	28·71
Bismuth	1·62	4·13	6·58
Lead	0·10	traces	0·10
Cobalt	0·16	0·76	1·07
Antimony	1·70	1·90	1·50
Arsenic	40·15	30·96	30·30
Sulphur	16·34	15·92	14·60
Gangue	6·10	4·90	5·70
Water and loss ..	1·93	2·22	2·44
	100·00	100·00	100·00

The gangue consists of a hydrated silicate of alumina, lime, and magnesia, partially soluble in acids. The mineral also contains 8 grms. of silver in 100 kilos., and a trace of gold not determinable.

Certain Apparatus for Fractionated Distillation.—MM. A. Henninger and J. A. Le Bel.—This paper requires an illustration.

Fluoxyborates.—M. A. Basarow.—The author has examined the fluoxyborates of soda described by Berzelius, and considers them mixtures, as by fractionated distillation he has resolved them into portions widely differing in composition.

Nature and Determination of the Sulphuretted Principles in Mineral Springs.—M. F. Garrigou.—An analysis of the waters of the Bayen spring, near Luchon.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 12, June 20, 1874.

Use of Granulated Iron in Place of Granulated Lead in Rinsing Bottles.—M. Fordos.—The author points out the danger of using leaden shot in cleansing bottles intended to contain beverages, medicines, &c. In their stead he recommends fragments of iron obtained by clipping up iron wire, No. 16, 17, and 18 giving a quality suitable for phials, and No. 22 for wine bottles. These iron granules have been used on the large scale with very satisfactory results. If there is any fear of injuring the colour of choice white wines granulated tin may be used.

Compounds of Cerium.—Severin Jolly.—The author has prepared and examined—the crystalline chloride, $CeCl_3+7H_2O$; the chloro-mercurate,—

$$CeCl_3+4HgCl_2+10H_2O;$$

chloro-platinate, $CeCl_3+PtCl_4+13H_2O$; chlor-aurate, $CeCl_3+AuCl_3+13H_2O$; bromide, $CeBr_3+\times H_2O$; bromaurate, $CeBr_3+AuBr_3+8H_2O$; fluoride, $2CeFl_3+H_2O$; sulphocyanide, $Ce(CNS)_3+7H_2O$; sulphocyanide with mercuric cyanide, $Ce(CNS)_3+3Hg(CN)_2+12H_2O$; ferrocyanide of cerium and potassium,—

$$\left.\begin{matrix}Ce\\K\end{matrix}\right\}Cy_6Fe+3H_2O;$$

ferricyanide, $Ce_2Cy_{12}Fe_2+8H_2O$; platino-cyanide,—

$$2CeCy_3+3PtCy_2+18H_2O;$$

nitrate, $(NO_3)_3Ce+6H_2O$; perchlorate, $(ClO_4)_3Ce+8H_2O$; iodate, $(IO_3)_3Ce+2H_2O$ (a periodate does not appear to exist; sulphates—*a*, $(SO_4)_3Ce_2+5H_2O$; *b*,—

$$(SO_4)_3Ce_2+6H_2O;$$

c, $(SO_4)_3Ce_2+8H_2O$; *d*, $(SO_4)_3Ce_2+9H_2O$; *e*,—

$$(SO_4)_3Ce_2+12H_2O;$$

Double sulphate of cerium and potassium,—

$$(SO_4)_3Ce_2+3SO_4K_2;$$

sulphate of cerium and ammonium,—

$$(SO_4)_3Ce_2+SO_4(NH_4)_2+8H_2O;$$

sulphate of cerium and sodium,—

$$(SO_4)_3Ce_2+SO_4Na_2+2H_2O;$$

seleniate—*a*, $(SeO_4)_3Ce_2+6H_2O$; *b*, $(SeO_4)_3Ce_2+9H_2O$; *c*, $(SeO_4)_3Ce_2+12H_2O$; seleniate of cerium and potassium, $(SeO_4)_3Ce_2+5SeO_4K_2$; seleniate of cerium and ammonium, $(SeO_4)_3Ce_2+SeO_4(NH_4)_2+9H_2O$; seleniate of cerium and sodium, $(SeO_4)_3Ce_2+SeO_4Na_2+5H_2O$. Selenite, $(SeO_3)_3Ce_2+3H_2O$; *b*, $(SeO_3)_2CeH+2H_2O$; hyposulphate, $(S_2O_6)_3Ce_2+24H_2O$; sulphite,—

$$(SO_3)_3Ce_2+3H_2O;$$

carbonate, $(CO_3)_3Ce_2+5H_2O$; carbonate of cerium and potassium, $(CO_3)_3Ce_2+CO_3K_2+3H_2O$; carbonate of cerium and sodium, $(CO_3)_3Ce_2+2CO_3Na_2+2H_2O$; ortho-phosphate, PO_4Ce+2H_2O; pyro-phosphate,—

$$P_2O_7HCe+3H_2O;$$

formiate, $(CO_2H)_3Ce$; acetate, $2(C_2H_3O_2)_3Ce+3H_2O$; oxalate, $(C_2O_4)_3Ce_2+9H_2O$.

Apparatus for the Continuous Preparation of Chlorine in the Cold.—M. A. Mercet.—Chloride of lime in contact with hydrochloric acid may be used for liberating chlorine at will. The apparatus is that of M. Deville, and consists of two flasks connected by an india-rubber tube, one containing a mixture of 3 parts by measure of ordinary hydrochloric acid and 1 of water, and the other containing the chloride of lime, placed upon a layer of broken glass. The chloride of lime is first made into a thick paste with water, and is then rolled with the hands into egg-shaped masses the size of a nut. These are then exposed to the air for some hours before use.

Process for Preparing Active Amylic Alcohol.—J. A. Le Bel.—The author set out with an attempt to ascertain the cause of the anomaly of the chloride of amyl, which is lævo-rotatory, whilst the iodide and bromide of the same radical are dextro-rotatory. Having prepared chloride of amyl by Balard's method, the rotation was found not left, but *nil*. This distinction may may be due to the elimination by the hydrochloric acid of a certain amount of lævo-rotatory alcohol which had remained in the chloride. To remove the last traces of amylic alcohol remaining in the chloride, agitation with sulphuric acid and treatment with perchloride of phosphorus were successively employed. The two products were both dextro-rotatory.

Means of Distinguishing Phormium from Hemp, Flax, &c.—M. E. Vitrebert.—The sample is immersed in the aqueous solution of an aniline colour, magenta or blue (though with the latter the reaction is less distinct), containing about a decigramme of colour to a litre. It is left in the solution for some hours in the cold, or for some seconds at 70° to 80°. It is then washed in water and examined. All the fibres of the phormium will be found decidedly coloured, whilst those of hemp or flax will be white. This test is more sensitive than that with nitric acid, and previous bleaching does not modify the reaction. If, after contact with the colouring matter, the swatch is washed with soap lyes the distinction is still more striking, for the phormium remains red, whilst hemp is very white. Ammonia may also serve to distinguish phormium from hemp when the fabric has been bleached. If the swatch is steeped in this alkali the phormium resumes its natural colour, whilst hemp remains white.

Action of Sulph-Urea and Bisulphide of Carbon on Argentic Urea.—M. J. Ponomareff.—The reaction between the former body and argentic urea may be represented by the equation—

$$CON_2H_2Ag_2+CSN_2H_4=Ag_2S+CON_2H_4+CN_2H_2.$$

With the sulphide of carbon the reaction may be expressed by—$CON_2H_2Ag_2+CS_2+H_2O=N_2S+COS+CON_2H_4$.

Researches on the Preparation of Organo-Metallic Compounds of the Hydrocarbons Belonging to the Series C_nH_{2n}.—Donato Tommasi.—Not adapted for abstraction.

Action of Chloride of Benzyl upon Camphor.—Donato Tomassi.—A continuation of the author's former paper on the same subject.

Promiscuous Notes.—Fr. Stolba.—

Reduction of Selenious Acid by Glucose.—If selenious acid is boiled in a flask with glucose and an excess of potash no selenium is deposited, but as soon as the solution is exposed to the air a red scum is formed, which gradually increases. It appears that boiling alkalies re-dissolve selenium. These reactions may, perhaps, serve for separating selenium and tellurium.

Reduction of Telluric Acid by Glucose.—When glucose is added to a solution of tellurate of ammonia, treated at a boiling heat with an alkali or an alkaline carbonate till the ammonia is expelled, a colouration appears, followed by a deposit of tellurium in black flakes. This deposit is not as rapid as with tellurous acid, but the precipitation of the tellurium is complete. This reaction allows of the preparation of pure tellurium.

Purification of Chlorine.—The author frees chlorine from hydrochloric acid gas by washing, first in a moderately concentrated solution of sulphate of copper, and then in water.

Preparation of Carbonic Acid by Fermentation.—The author dissolves raw sugar in 4 parts of water by weight, and adds ½ per cent in volume of yeast. The fermentation sets in after a few hours, and may be regulated by raising or lowering the temperature. If it ceases more sugar may be added, or, in case of need, a little more yeast. The vessel must be spacious.

Extraction of Thallium.—To extract thallium from the mud of the lead chambers the author sprinkles it with sulphuric acid, exhausts with boiling water, and evaporates the solution to crystallisation, after adding a little sulphate of alumina. The last mother-liquors are precipitated with hydrochloric acid. The crystals of thallium alum may be re-crystallised, and then decomposed by means of zinc; or the thallium may be precipitated as chloride.

Optical Property of Crystals of Sulphate of Copper.—If we receive the solar light reflected by a large crystal of sulphate of copper upon a sheet of platinum or tin plate, placed at a small distance from the crystal, the sheet assumes the colour of metallic copper upon the part which receives the reflected light.

Action of Fluosilicic Acid upon Salts of Cerium.—When this acid is added to certain salts of cerium, lanthanum, and didymium, especially the acetate, there appears a turbidity, or an amorphous precipitate. This does not appear with other salts, except after addition of sulphate of copper. The fluosilicates thus obtained are sparingly soluble in water, acetic acid, and fluosilic acid, but dissolve in most mineral acids. Alcohol facilitates their precipitation.

Crystallisation of Tin.—A fine crystallisation of tin is obtained as follows:—A platinum capsule is covered with an outer coating of paraffin or wax, leaving the bottom only uncovered. This capsule is set upon a plate of amalgamated zinc in a porcelain capsule. The platinum is then filled completely full of a dilute and not too acid solution of chloride of tin, whilst the porcelain is filled with water acidulated with 1-20th of hydrochloric acid, so that its surface comes in contact with the surface of the liquid in the platinum. A feeble electric current is set up, which reduces the salt of tin. The crystals formed after a few days are well developed. They are washed with water and dried quickly.

Determination of Cyanide of Potassium in Silver Baths.—G. C. Wittstein.—The object of this determination is to know the quantity of *free* cyanide which exists in a silver-plating bath, and consequently the amount of silver which must be added to the bath to restore it to activity. The method consists in transforming the cyanide into acetate, dissolving the latter in absolute alcohol, and converting it into chloride, which is weighed. But all the potassium contained in the bath is weighed in the state of free cyanide of potassium, of double cyanide, of carbonate, and of cyanate, and by these special operations its divers elements are determined.

Determination of Total Potassium.—10 c.c. of acetic acid are added to 20 c.c. of the silver bath. It is evaporated to dryness, the residue digested for twenty-four hours with absolute alcohol, the liquid decanted, the deposit washed with alcohol, evaporated almost to dryness; 5 c.c. of hydrochloric acid are added, it is dried, and the chloride of potassium obtained is weighed (A).

Determination of Double Cyanide.—The silver is precipitated with sulphide of ammonium, and the sulphide of silver is weighed. From its weight the corresponding quantity of cyanide of silver, cyanide of potassium, and chloride of potassium (B), are calculated.

Determination of the Carbonate.—Precipitate with chloride of calcium, and weigh the carbonate of lime, from which can be calculated the carbonate of potash, and the weight (C) of chloride of potassium which it has yielded in the first operation.

Determination of Cyanate.—Cyanide of potassium when melted contains cyanate in the proportion—

$$7KCy + 3CyKO,$$

or 34·8 per cent. In every 100 of potassium furnished by the mixture, 30 are yielded by the cyanate. After having therefore, deducted from the total A the weights B+C, 30 per cent must still be subtracted to find the weight yielded by free cyanide. The method is sufficiently exact for practical purposes.

Utilisation of Tin Waste.—M. Kuenzel.—The process includes the following operations:—Boiling the waste with water acidulated with hydrochloric and nitric acid, until the tin is completely dissolved. To 1000 kilos. of waste containing 5 to 6 per cent of tin, 300 kilos. of crude hydrochloric acid and 30 kilos. of crude nitric are used, with water enough to cover four-fifths of the heap. The operation is carried on in tanks of wood or brick, 3 metres cube, lined with a composition of 2 parts of sand and 1 part of melted sulphur, and heated by steam. The action lasts from thirty to forty-five minutes. The liquid is then run off, the scrap-iron washed, and the washings used in treating the next lot. The tin is precipitated in a spongy state by means of scrap-zinc, 70 parts of which serve for 100 of tin. The precipitated mass is washed, and at once dissolved in hydrochloric acid. There remains a mass composed of chloride of lead and oxide of tin; this is mixed with double its weight of coke, and heated in a zinc furnace. Chloride of tin distils over, and metallic lead remains. The iron scrap, freed from tin, can be used in the manufacture of copperas, or in metallurgical operations. The author subjoins figures which show a fair working profit on the process.

Reimann's Farber Zeitung, No. 32, 1874.

This number contains a notice on the utilisation of old vat-nets which contain from 5 to 15 lbs. of indigo.

There is a notice of Australia fibre, a textile vegetable matter preferable to jute and possessing a greater affinity for colours; receipts for a Nicholson blue on this fibre; a bright and fast brown on cotton yarn; a fast black on mixed garments; a black on linen; and a continuation of the instructions for the hydrosulphite indigo process. Next follows an article for dyeing "Beider-wand," a provincial German tissue of wool and linen, and an account of a new apparatus for steaming printed pieces.

G. Witz ascribes the turning green of aniline blacks in presence of acid oxidising agents merely to the acid, and not to any deoxidisation or even oxidation.

No. 33, 1874.

This number contains general instructions on dyeing with aniline colours, containing nothing remarkable; a continuation of the essay on "Beider-wand," and of the instructions for the hydrosulphite process; receipts for a light olive on cotton yarn; for a pansy on vienna; for printing a fawn on calico; and for the galvanic deposition of copper on iron cylinders for printing.

No. 34, 1874.

This number contains a continuation of the article on dyeing with anilines; a notice of a new finishing machine; receipts for a ponceau, a grey, and a maize on silk, and a reddish brown on woollen yarn; a continuation of the paper on "Beider-wand;" a notice of the state of the cotton manufactures in the French Department of Seine Inferieure; and a description of Fohl's apparatus for the recovery of benzol, &c., used in extracting fatty matters.

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THE CHEMICAL NEWS.

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ON SULPHUR DI-IODIDE.

By R. W. EMERSON MACIVOR.

When an intimate mixture of sulphur and iodine, in the proportion of one atom of the former element to two of the latter, is heated, there results a dark-coloured substance, somewhat resembling in appearance native antimony trisulphide, or stibite, which is generally considered to be sulphur di-iodide, $''''S''I_2$.

It smells very strongly of free iodine, and when heated *in vacuo* yields a sublimate composed of almost pure iodine and a residue of sulphur. It is insoluble in water, but dissolves in carbon disulphide, yielding a solution having the magnificent violet colour characteristic of a solution of free iodine in this menstruum, and leaving, on evaporation, a residue in which, on examination with a magnifying-glass, crystals of sulphur and iodine are discernible. By continued washing with absolute alcohol, the whole of the iodine contained in the substance may be abstracted, and a residue of sulphur left, which dissolves in carbon disulphide. Ether also dissolves out the iodine.

As the properties enumerated above are those which would be expected to characterise a mechanical mixture of sulphur with iodine, I am much inclined to doubt the compound nature of the product obtained by simply heating the two elements together.

Glasgow, 1874.

NOTES ON ALLOXANTIN AND MUREXIDE.

By JAMES REOCH, M.A., M.B.

When urine is boiled with an acid solution of molybdate of ammonium, it invariably turns green. If about 4 c.c. of urine are used, and two drops of the molybdate and two of strong HCl, the colour is produced at once on boiling, but deepens for some time afterwards. Now, four reagents are mentioned in chemical works as capable of producing the blue oxide of molybdenum, but of these nascent hydrogen alone acts speedily and completely. To this alloxantin must be added, as I have always found it to reduce the molybdate at once, more especially when hot, and it is to this body that I believe the green colour produced in urine is due, the blue colour proper being mixed with yellow urine; at any rate, none of the ordinary constituents of urine, urea, uric acid, hippuric acid, or salts, either separately or combined, can reduce the molybdate; but, whether this be so or not, the test is of valuable application in determining the constitution of alloxantin, for the latter gives a violet precipitate with baryta- or lime-water, and if this be thrown on a filter, washed, and treated with dilute HCl or H_2SO_4, chloride or sulphate of barium or calcium will be formed, and if the filtrate be now tested for alloxantin by the acid molybdate, nearly as much will be found as was originally used. This experiment seems decisive in regard to the acid character of alloxantin, and it is further confirmed by the fact that it is acid to test-paper in a proportion equal to its combining weight. I have added lime-water to a solution of a weighed quantity of alloxantin, and then dilute H_2SO_4, by which I have obtained an acidity of 297 as the mean of several experiments. This result approximates to 322, sufficiently allowing for the loss which invariably occurs from the decomposition of these organic compounds by the very boiling required to effect their solution to show that it is a dibasic acid. It is, however, easily decomposed by KHO or NaHO by prolonged boiling, probably with the production of a carbonate, for the acid molybdate reaction is soon negatived, and baryta-water gives a white precipitate which effervesces on adding HCl. Much dispute has arisen as to the nature of murexide, on which I have a few facts to contribute. When pure and dry murexide is treated with strong HCl in the proportion of about 2 c.c. to 150 m.grms., and the mixture stirred with a glass rod, the microscope will reveal crystals of alloxantin instead of the prisms of murexide, the process of decomposition may be watched under the microscope, when the prisms will be seen to break up into a multitude of smaller prisms, which are speedily dissolved; in a short time, larger or smaller crystals of alloxantin start into view. Again, if 1 grm. of murexide be dissolved by boiling with 3 ozs. of strong HCl, and 3 ozs. of H_2O be added, beautiful crystals of alloxantin are deposited in twenty-four to forty-eight hours; if a larger quantity be used, the precipitate is delayed. In this way, about 30 or 40 per cent can be obtained.

Now, when 150 m.grms. of murexide are boiled with 2 c.c. of HCl till solution is effected, and rapidly cooled, a precipitate takes place in a few minutes, which is sometimes called murexan, but which, from what I have said above, must contain a large quantity of alloxantin; in fact, the crystals are easily recognised as flat plates having an angle of about 105°, and giving the acid molybdate test. But when murexide is dissolved in KHO, and dilute H_2SO_4 added, a precipitate is formed which is not alloxantin, though containing a small quantity, but is really murexan. These facts may serve to explain the constitution of murexan, as being composed of uramil with a greater or less quantity of alloxantin, and may account for the varying analyses of that body. Though alloxantin is thus readily got from murexide, the latter is not a compound of the former with NH_3, for HCl invariably gives a yellow solution with murexide, showing that another body is formed besides NH_4Cl and alloxantin.

Murexide is one of the most intense of pigments; a test-tube containing only 1 part in 12,000,000 looks decidedly pink when placed on a sheet of white paper, and this fact may account for the common idea that it is a very unstable body. No doubt it is easily decomposed, but the yellow pigment which HCl transforms it into is several hundred times less intense as a pigment, and it may therefore easily be overlooked when only small quantities are operated on. That murexide is not of weak constitution is proved by the very mode of its production, by oxidising uric acid; and here I may correct a common error. It is said that, when uric acid is heated with HNO_3, a red residue is left, which becomes crimson by the vapour of NH_3. The fact is, that the red residue is impure murexide, and becomes crimson merely by H_2O; the only use of NH_3 is where the residue is not quite dry, for a trace of HNO_3 would easily destroy the colour, and the NH_3 would neutralise this; but anyone can satisfy himself that murexide is produced without the NH_3. It is also produced in many other ways; for the red colour which alloxan assumes in the air or when heated is due to this cause, and by cautious treatment with strong HCl I have obtained alloxantin crystals from it; so, also, alloxantin in moist air turns pink. Only a small proportion of murexide is got from these bodies, from uric acid, for example, not above $\frac{1}{30}$th part; but its colour is so intense that a small quantity readily shows itself. It is usually said that murexide contains 3 or 4 per cent of H_2O; but this is quite unessential, for even when heated to carbonisation the prisms for the most part retain their form, so that it can be dried without decomposition. It is also said to redden litmus, but it dyes all kinds of paper, so that it should be treated with dilute H_2SO_4 till decolourised, and then with NaHO. When this is done, it will be found that the murexide makes no difference in the quantity required for neutralisation; it is, therefore, itself a salt or neutral body. By heating it with NaHO first, till decolourised, and then using H_2SO_4, it is found that at least one equivalent of NH_3 has been given off; but the result is not quite uniform, probably owing to the fact that the decomposition is complex, and that small quantities of NH_3 are given off from some of the other products.

CROISSANT AND BRETONNIERE'S NEW COLOURS.

These new dyes are now manufactured on a large scale, and have ceased to be regarded as mere chemical curiosities. They are distinguished for their great tinctorial power, their remarkable permanence, and their cheapness. Except red, blue, green, and their modifications all colours can thus be produced. Very fine results are obtained by mixing the new dyes with the woods, which, however, will be almost superseded by the former. The cost of manufacture is so trifling that a cwt. dye from sawdust—which will prove a substitute for logwood—costs only thirty shillings, whilst the equivalent amount of extract of logwood costs £7 10s. Extract of chestnut, 1·2 fr. per kilo., is only raised in price 5 centimes, extract of fustic 20 centimes, and extract of logwood 68 centimes by conversion into the new colours, whilst their tintorial power is rendered three or four times greater. To produce a good grey on 10 kilos. of material, 0·25 kilo. of sawdust is sufficient. In permanence the new colours greatly outstrip those now in use. They are not affected by light, acids, oxalate of potash, nor even by hot soda-lye. Concentrated chlorine alone attacks them. When used along with other colours they render the latter more permanent, especially the aniline preparations. Varieties of shade are not produced by mixtures, but by regulating the temperature to which the colour is exposed in the course of manufacture. The colours have been used for some time in various establishments in Lille, Roubaix, Cholet, Rouen, and Laval Garne, and have given great satisfaction.

The process of dyeing is as follows:—The colours are dissolved in hot water, and the goods are steeped and turned in the solution from 30 to 45 minutes. They are fixed by a hot solution of bichromate of potash, in which they are left for about 15 minutes, washed with pure water, treated—in case of wool and silk—with acid to remove excess of alkali [Should not this process come after the next described operation?], and then placed in an alkaline bath made up with ¼ kilo. soda to 45 litres of water, washing finally with clear water.—(*Der Arbeitgeber.*)

The following additional particulars are taken from a pamphlet issued by the "Patent Farben-Fabrik" of Göttingen—an establishment devoted to the manufacture of the new colours.

The Société Industrielle of Mühlhausen has found that these colours attach themselves permanently to the fibre, by the mere evaporation of the water in which they are dissolved,—a circumstance of great importance in calico-printing. All the colours are soluble in water, and are precipitable by mineral as well as organic acids and metallic salts. The colours have a remarkable affinity for both animal and vegetable fibres, upon which they have no injurious action.

The new colours dye wool, silk, linen, and cotton equally well. Hence mixed goods can be dyed in one operation without appearing checkered, the colour producing one and same tone of equal intensity, both upon the weft and the warp. In dyeing, after the colour and the chrome baths, the goods are passed through a boiling soda-bath, and washed in abundance of water. Animal fibre may require the addition of a little acetic acid to remove the last traces of alkali. Other metallic salts may be used instead of chrome, according to the particular effect desired.

The following receipts have been in successful use in the works of the inventors. They are all adapted to 20 kilos. of linen or 13 of cotton. The numbers are the distinguishing marks of different dyes.

1. *Greys.*

No. 1. 268 grms. in 90 litres water free from lime.
No. 1. 670 ,, ,, ,, ,,
No. 1. 1200 ,, ,, ,, ,,

2. *Yellowish Shades.*

No. 7. 400 grms. in 90 litres water free from lime.
No. 7. 1200 ,, ,, ,, ,,

3. *Other Modes.*

No. 1. 670 grms. } in 90 litres water as above.
No. 11. 667 ,, }
No. 11. 400 ,, ,, ,, ,,
No. 11. 800 ,, ,, ,, ,,
No. 11. 600 ,, } in 90 litres water.
No. 13. 2 litres }
No. 13. 4 ,, ,, ,,
No. 13. 3 ,, ,, ,,

4. *Browns and Blacks.*

No. 15. 1200 grms. in 90 litres water.
No. 15. 400 ,, ,, ,,
No. 18. 1200 ,, ,, ,,
No. 18. 400 ,, ,, ,,
No. 1. 700 }
No. 11. 1000 } ,, ,, ,,
No. 1. 100 ,, }
No. 13. 1½ litres } ,, ,,

Chrome-bath for the above quantities.

Bichromate of potash 105 grms.
Water ,, 80 litres.

Soda-bath.

Soda 1 kilo.
Water 80 litres.

The water must in all cases be free from lime.

We may add that we have been favoured with samples of several of the colours, and as far as laboratory experiments can go we find that their properties are really as described.

ON ANTHRACEN AND ALIZARIN.[*]

By FREDERICK VERSMANN, Ph.D.,

In accepting the invitation to lecture before you on one of the most important and most interesting recent chemical discoveries, I had to consider whether I should treat my subject in preference from a practical or from a scientific point of view.

Looking at the object for which this series of chemical lectures has been arranged by the Council, and believing it to be decidedly of a practical nature, I have thought it best to confine myself as much as possible to the practical side of my subject, and to consider the theoretical part only so much as may be necessary for a general understanding. I have done so all the more readily because I shall thereby be best enabled to point out the great advantage and the absolute necessity of constant scientific investigation of apparently very simple manufacturing processes, and also because I am anxious to invite a discussion on several practical points, which are surrounded by much uncertainty; and I should be much pleased if such discussion should assist in clearing away some of the uncertainty and dissatisfaction at present attached to the true value of an article which suddenly has assumed such vast importance.

I may at once remark that, although my paper is "On Anthracen and Alizarin," I have found it impossible to do full justice to both subjects in one evening. I shall therefore limit myself to-night chiefly to the consideration of anthracen, and I shall touch but lightly upon its conversion into colouring matter; but I hope I may have at some future time an opportunity given me to fully discuss the various processes which produce these chemical changes, and result in such splendid and beautiful compounds.

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[*] Read before the Society of Arts, Chemical Section.

In tracing the history of anthracen, we find that the two great French chemists, Dumas and Laurent, in 1832, first obtained it from the last fractions of the distillation of coal-tar; they exposed the oily matter to extreme cold, when a crystalline deposit separated, which was pressed and washed with alcohol; the residue was further purified by re-distillation, crystallisation, and sublimation, and was then submitted to chemical investigation. Dumas and Laurent assigned to the compound thus obtained the formula $C_{15}H_{12}$, and as this is half as much again as naphthalen, $C_{10}H_8$, they named the new substance para-naphthalen. But this chemical composition and the low melting-point, which was found to be 180° C., convincingly prove that the substance must have been a mixture of several hydrocarbons, and not a definite chemical compound.

Laurent afterwards submitted the substance to fresh investigations, and obtained several interesting derivatives, but, as Professor Kopp suggests in his exhaustive historical memoir on "Anthracen and its Derivatives," published in the *Moniteur Scientifique*, Laurent evidently had at his disposal only small quantities of the impure hydrocarbon; he therefore could not determine the true composition of the substance, which he now named anthracen.

At present it is generally acknowledged that the compound these two chemists investigated was not pure, and that their formula is not correct; it is therefore the more surprising that Girard and De Laire, in their "Traité des Dérivés de la Houille," published only last year, repeat with strange tenacity Dumas and Laurent's antiquated statements; they treat para-naphthalen as an existing definite compound of the formula $C_{15}H_{12}$, although they have nothing new to add in support of their isolated opinion; on the contrary, they confess that the substance is little known, that the investigations are very old, and made very likely not with a pure compound, but with a mixture of para-naphthalen and anthracen.

Fritsche described, in 1857, a hydrocarbon, obtained from coal-tar, which he found in many respects closely to resemble Laurent's anthracen, but which had a melting-point of 210° to 212° C., and the formula of which he found to be $C_{14}H_{10}$.

Anderson published, in 1862, a most searching investigation of the higher hydrocarbons from coal-tar; he separated anthracen in great purity, obtained many of its most important derivatives, prominent amongst which stands his oxanthracen, or anthrachinon, which, however, had already been obtained by Laurent. Anderson retained Laurent's name of anthracen, but confirmed Fritsche's formula and melting-point.

So far, then, the hydrocarbon had been separated from coal-tar only, but in 1866 Limpricht demonstrated its formation, resulting from the decomposition of chloride of benzyl by water in a closed vessel at 180° C.; and in the same year Berthelot commenced the publication of his masterly researches on the action of heat upon the hydrocarbons, their origin, character, and composition; he pointed out the circumstances under which anthracen is formed by the action of heat upon the several more simple hydrocarbons; he found that toluol alone, or a mixture of styrol and benzol, or of benzol and ethylen, passed through a red-hot tube, furnished anthracen.

Berthelot's and Limpricht's results are so far exclusively of theoretical interest, at present at least, there does not appear any chance of their investigations being capable of practical application. Berthelot also described the extraction of anthracen from coal-tar, its purification, and its characters, and he confirmed Anderson's results. So far, all these investigations were of a purely scientific character, but in 1868 two German chemists, Graebe and Liebermann, succeeded in reducing alizarin, extracted from madder, and in obtaining therefrom a hydrocarbon which corresponds in all its properties to Anderson's anthracen.

This, then, is the starting-point of one of the greatest revolutions in chemical industry, because, after having obtained anthracen from alizarin, it was comparatively easy to convert anthracen into alizarin, and thus the possibility was given of producing, by artificial means, one of the most important and most ancient natural colouring matters.

Several German manufacturers of aniline dyes at once commenced the solution of this problem, with more or less rapid success, and, although scarcely five years have elapsed since the first laboratory experiment was made, to-day we see a number of large works producing vast quantities of the artificial colour. The first and most important question became, of course, the sufficient supply of anthracen.

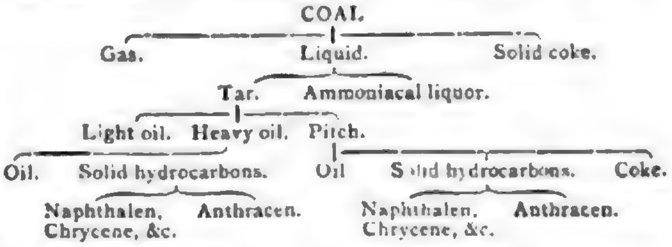
It is difficult to realise the idea that an article which was but yesterday unknown and useless, and of no commercial value whatever, should to-day be most eagerly sought after, and should command a high price. Such, however, is the case with anthracen, which has suddenly risen to greater importance than any of the other products of the distillation of coal-tar. True, the application of benzol and its homologues imparted to this series of hydrocarbons an importance previously unknown, but it becomes almost insignificant if compared with the position anthracen has so suddenly, and no doubt permanently, assumed.

Before attempting to give a description of the manufacture of anthracen, I may be allowed for a moment to go a step further back, to draw your attention to the formation of tar, from which anthracen is obtained.

I need scarcely say that tar is one of the by-products in the manufacture of illuminating gas. Coal, heated in a closed red-hot retort, is split up into a series of volatile and non-volatile compounds; the last remain in the retort as coke, while the volatile compounds are carried away by means of an exhauster; they pass through the ascension pipe at one end of the retort into an hydraulic main, and then into the condensers. These are large upright syphons, and as the volatile compounds are made to pass through a whole series they are cooled. The permanent gases pass on to be further purified and to be stored in the gas-holders, while other products, carried away so far in the form of hot vapour, are condensed in the liquid form, and accumulate at the bottom. These liquid products consist chiefly of tar and water, which separate on standing; the tar is run off into the tar-wells, and is ready for further treatment.

In drawing your attention to the following table, in which I have endeavoured to illustrate and to follow up the ultimate separation of anthracen from tar, but, starting with coal and its conversion into gas and its by-products, I need scarcely remark that I could not have intended to give a complete representation of all the different compounds obtained in the operation, but that I have simply grouped them together in as few divisions as possible:—

PRODUCTS OF DESTRUCTIVE DISTILLATION OF COAL.



We have already seen that coal submitted to destructive distillation yields gaseous, liquid, and solid products. Passing over the gas and the solid, we separate the liquid into tar and into water containing much ammonia, and which is therefore called ammoniacal liquor. The tar submitted to fractional distillations yields light oil, heavy oil, and pitch. These, I repeat, are only broad divisions, as obtained by the first distillation of tar. The oils contain several series of liquid hydrocarbons, the most important of which is the benzol series; a series of bases containing nitrogen, of which aniline is the type; a series of acids, foremost amongst which is carbolic acid; and, lastly, a whole series of hydrocarbons, most prominent amongst which we find anthracen.

Perhaps I ought to have given a complete list of all these compounds, with some of their characteristic physical properties, but as their number is very considerable—more than sixty at least,—I have limited myself to the solid hydrocarbons as the only ones bearing directly upon our subject. These we shall have to consider later on, when speaking of the impurities which accompany anthracen.

The pitch resulting from tar is further divided, ultimately yielding again anthracen. This is a process I shall have to speak of separately.

The manufacture of anthracen appears at the first moment to be extremely simple, an impression which, unfortunately, has taken hold of many tar distillers, and which accounts for the low quality of very large quantities of anthracen sold.

The well-known process of tar distilling, so the formula runs, is carried out as usual, and the last 10 or 15 per cent of the products of the distillation are set aside and allowed to stand for some weeks, when a crystalline deposit of solid hydrocarbons separates; this is freed as much as possible from the adherent oil by filtration, pressing, or other mechanical means, when the residue, more or less dry and more or less impure, is ready for sale.

This, no doubt, is the necessary beginning of the process, which, however, should be further followed up, and ultimately result in an article of such purity that it might at once be converted into colouring matter, *i.e.*, an article containing at least 75 or 80 per cent of pure anthracen.

True, in the early days of anthracen—and that is but four years ago—the alizarine makers were well contented to get anthracen of any quality, however low in percentage, because the success and very life of the new dye depended upon the possibility of getting large quantities of a hitherto unknown article. At that time the alizarine-maker bought what he could get, often perhaps not knowing himself the value of the articles bought; but it is evident he did so unwillingly and only of necessity, as is clearly shown by some remarks of Dr. Gessort's, one of the earliest and most successful manufacturers of alizarin, who wrote about three years ago as follows:—

"It is to be regretted that the tar distillers are not more careful in the manufacture of commercial anthracen. The manufacturer of alizarin has not at his disposal the necessary plant required for the purification of crude anthracen; at all events, he loses much time, and has no use for the oily residues resulting from the purification.

"The tar distillers, on the other hand, can always use these by-products along with their other oils. They ought to take the greatest care in the pressing of the well-filtered and drained anthracen, by using powerful hydraulic presses and by pressing, first cold and then hot, as strongly as possible. Such crude well-pressed anthracen is readily powdered and passed through a sieve, and in this state of fine division it may be treated with petroleum spirit, boiling between 70° and 90° C., and after sufficient washing it may again be submitted to strong pressure.

"The price of crude anthracen of good quality is sufficiently high and remunerative to induce the tar distiller well to study the rational manufacture of the article, and to devote all his care to it."

Every word of these remarks, written three years ago, holds good even to-day, because only very few distillers are aware of the profit to be derived from purifying their crude product and thus obtaining a high-class article. It is also true that, now that the question of producing large quantities of anthracen has been settled, the alizarin manufacturer buys but unwillingly a low per cent article and we see a new class of manufacturers spring up, which stand between the two former ones, *viz.*, anthracen purifiers, who buy the crude anthracen and supply the consumer with an article of the desired purity. Of these anthracen purifiers there are several in Germany and at least one in England; and nothing could speak more strongly in favour of my argument—that the first manufacturer should also be the purifier—than the fact that other people find it profitable to take up the purification as a separate business.

Of course, I do not for a moment under-estimate the difficulties connected with the subject; on the contrary, I am anxious to point them out, and to express my strong opinion that the whole manufacture must be looked upon, not so much as a mechanical, but rather as a chemical, operation,—that it requires a chemist's constant care and scientific investigation, without which only partially satisfactory results can be ascertained; because, after first having obtained the crude product, what is the question to be solved? Is it not the separation of one substance from a number of other substances extremely similar in their physical properties; and can such separation be successfully carried out, especially on the manufacturing scale, without an intimate acquaintance with all these substances? Certainly not; and, moreover, the production of the first article ought to be based upon scientific principles as well, because we must assume—and there is little doubt of this view being correct—that the greatest part of these solid hydrocarbons does not exist ready formed in the tar, is during the distillation not simply vapourised and afterwards again condensed, but that it is the product of decomposition by heat of more simple compounds; and, if this be so, will not the study of the effects of heat under varying circumstances become of the utmost importance, and lead to most valuable results? I do not lose sight of the fact that, for the tar distiller, the mechanical part of his business is of the greatest importance, such as the suitable arrangement of his plant, the economical carriage from one part of the works to the other of the bulky raw material and its products, &c.; but in order to derive full benefit from his operations he should be guided and assisted by experience derived from investigation.

(To be continued).

NOTICES OF BOOKS.

An Elementary Treatise on Practical Chemistry and Qualitative Inorganic Analysis. By Frank Clowes, B.Sc. Lond. London: J. and A. Churchill.

This book adds another to the many handbooks of qualitative analysis, the author's reason for writing it being the discovery that "the want of a sufficiently elementary and explanatory laboratory text-book was very widely felt." The student who could not find among the many manuals on analysis one well suited for his purpose would certainly be hard to please, but at the same time he would have little cause for dissatisfaction with Mr. Clowes's production, which is certainly all it professes to be.

The first section is devoted to the preparation and properties of a few of the principal useful gases, the distillation of water, and the preparation of nitric acid. In the following section, the author describes the preparation and use of apparatus, and gives a number of directions and hints which every beginner will appreciate. A separate chapter is devoted to manipulation.

There is little that is new in the analytical reactions or the methods of analysis, and many of the special and characteristic tests are omitted, unless utilised in the systematic methods. This is certainly a pity, for nothing is of greater interest to the intelligent student than the trial of reactions out of the ordinary routine. The plumbic dioxide test for manganese, the potassium iodide reaction with bismuth, and the decolouration of permanganate by ferrous salts might advantageously be mentioned; but, on the other hand, the tests described are fully dwelt on, and any necessary precautions pointed out. But few of the organic acids are referred to, and no mention is made of alkaloids or of rare metals. In our opinion, no text-book of qualitative analysis can be considered complete that does not include, at least in a supplementary form, the reactions and methods of detecting some of the rarer metals. Book after book appears, and the authors systematically ignore metals like tungsten, molybdenum, titanium, uranium, cerium, and lithium, whose compounds are to be found in every laboratory, and some of which elements are met with in nature and commerce quite as frequently as the metals bismuth, cadmium, and cobalt, which are included in every scheme of analysis. But, in this respect, the book in question merely follows the general example, which, unfortunately, is that set in our Government college, where the course of instruction is deficient in these and other particulars. We do not know a better handbook, going over the usual restricted ground, than that under review.

The author avoids the eccentricities of notation and nomenclature which disfigure some works on analysis, as he rightly considers that it is undesirable that the student's practical text-book should tempt him to bestow valuable time in the laboratory upon the study of matters of mere theoretical importance.

An Introdution to Pharmaceutical and Medical Chemistry (Theoretical and Practical). By John Muter, M.A., F.C.S., &c. London: Simpkin and Marshall.

This work is one of a somewhat special character, as its title implies, but the author has succeeded in introducing a great deal of useful and new matter of interest to all chemists, while the remarkable clearness of type and absence of typographical errors make the reading of it a pleasure.

The author's arrangement of matter is certainly peculiar, and is not without some advantages, though we are disposed to doubt whether these are sufficient to justify the plan adopted. Thus, when describing the analytical reactions of the "simple basylous radicals," the author classes them as monads, dyads, &c., a course which necessarily results in the juxtaposition of potassium and silver, magnesium and mercury, iron and tin. We are glad to see hydrogenium in its proper place at the head of the monad metals.

The electro-negative arrangement of the various pharmaceutical preparations will, we fear, prove somewhat perplexing to the student, though the author is thoroughly consistent, and treats of all the principal sulphates in order, from hydrogen-sulphate to indigo-sulphate.

There is one objectionable item of nomenclature, against which we really must protest, and that is the abuse of the prefix "hydro." Thus we have potassium hydro-tartrate, disodium hydro-phosphate, ethyl hydro-sulphate, quinine hydro-sulphate. The term hydrosulphate is applied to acid sulphates instead of to unoxidised sulphur derivatives. By ethyl hydrosulphate, chemists generally understand mercaptan, whereas Dr. Muter uses the name to indicate ethyl-sulphuric acid. The confusion caused by such a change is well-known by the fact that the acid sulphate of quinine is called the hydrosulphate, while the hydrochlorate does not mean the acid chlorate, but the hydrochloride. Hydrochlorate and hydrosulphate are incompatible terms.

A considerable portion of the book is devoted to a very ucid exposition of chemical principles, followed by equally well written descriptions of various laboratory processes and manipulations.

The sections on alcohol derivatives and ammonia derivatives (alkaloids, &c.) are especially good, the author being here thoroughly in his element; while the errors contained in a paragraph on the manufacture of iron and steel serve to show how difficult it is for a chemist to master the whole of his subject.

We have observed some rather serious errors in the analytical reactions and tables for systematic detection of metals. Thus, the solubility of calcium phosphate in ammonium citrate is ignored in a manner likely to bring the analyst to grief; again, we are directed to separate cadmium from copper by means of cyanide of potassium and hydrosulphuric acid, and to test for copper in the filtrate by acidifying with acetic acid and adding ferrocyanide, which is stated to give a chocolate-coloured precipitate. The author has here overlooked the fact that the addition of acetic acid would have thrown down cyanide and sulphide of copper. Such mistakes suggest the idea that the tables have not been in practical use. On page 153 we are told that all oxides dissolve in hydrochloric acid; while on page 220, the production of a white gelatinous precipitate, on adding excess of potassium hydrate to a solution of cadmium iodide, is said to indicate the absence of zinc!

But the errors are all of a minor kind, detracting but little from the actual value of the book, and readily corrected in a second edition, which the author promises to publish should the first find favour. This, we think, is certain to be the case, as the book is one of a very useful and original kind, and is brought up to the latest date, tests and processes published only a few months since being described in their proper places. A great many facts of pharmaceutical interest are mentioned which are not to be found in any other single work, and the author has certainly succeeded to a great extent in his original, but subsequently abandoned, plan of writing an "exhaustive treatise on chemistry, as applied to medicine and pharmacy."

Sewage no Value; the Sewage Difficulty Exploded. By E. Monson, Assoc. Inst. C.E. London: E. and F. N. Spon.

If the sewage difficulty is "exploded" in these pages, it is certainly not solved. There is little, if anything, here which is not perfectly familiar to all who have given their attention to the sewage question. There is, unfortunately, more than a little doubtful, if not utterly fallacious. The author admits that towns must not hope to sell their sewage, in accordance with certain theoretical valuations put forward to a great extent by the advocates of irrigation. But it by no means follows that sewage is of no value. Nor is it legitimate to say that the introduction of artificial manures has rendered the farmer independent of excremental matters. These artificial manures are made of bones, shoddy, leather, and certain minerals; but the supply of none of these is unlimited. If we go on, as we are doing, allowing the liquid and solid excrements of the population to be washed down to the sea, or if we treat them by any process which, like General Scott's cement scheme, withdraws them from organic circulation, the time must come when artificial manures will wax scarce. It is painful to find truths which Liebig has placed in so clear a light still ignored by one who comes forward to enlighten the public on a great social difficulty.

We find, further, the statement that, "if human excrement is removed by water, there is no way of purifying the water (so as to be?) fit for domestic use except by passing it through the soil." This is saying either too much or too little. We have met with no satisfactory evidence to show that the effluent from an irrigation farm, or an "intermittent downward filtration" bed, has any superiority over that obtainable by precipitation. But we should object to either the one or the other in our household. If the soil has such powers of disinfecting sew[illegible] as irrigationists asserts, how is it that the drainage of [illegible] pools, graveyards, &c., can penetrate through the

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unchanged, and poison wells at a considerable distance? We find, however, some admissions as to the effects of sewage irrigation, which, coming from one who is evidently no friend of chemical treatment, are doubly valuable. "Sewage, like water, retards the ripening of the fruit and grain, and develops the leaf." "Sewage cannot supersede manure, for it cakes the ground, seals up its pores, and prevents the air from getting at the roots of the crop." "Sewage cannot be utilised at a profit if it has to be pumped." "It has been found, says Burnell, at all times and in all climates, that irrigation develops the growth of the leaves at the expense of the fruit or grain."

If the first and last of the above-quoted passages express the truth, then to advocate irrigation is simply to agitate for the reduction of our native wheat supply. Is it wise to do this, if we remember that the countries from which we import grain are precisely those with which we are most likely to be engaged in hostilities?

"The land," we are told, "is the proper place for town refuse, and if sewage be disagreeable to the sense of smell it is not a nuisance injurious to health when upon the land." This is an oft repeated paradox. We are told that, if sewage runs in an open sewer, or is allowed to flow into rivers, the gases and vapours which rise from its surface are most prejudicial to health; yet at the same time we are expected to believe that, if such sewage is poured out over the surface of the earth, under circumstances calculated to promote evaporation, these very emanations cease to be injurious! The evidence obtained from India shows that irrigation, even with clean water, lowers the standard of health in the district. Precipitation, we must remember can be so conducted that nothing either offensive to the senses or injurious to health is given off at any stage of the process.

The author recommends that sewage intended for irrigation should be previously filtered. Now sewage is very difficult to filter, as has been lately proved on the large scale at Bradford, and as anyone may find who will try the experiment with a funnel, a filter-paper, and a pint of the liquid in question. Mr. Monson has himself admitted that it "cakes the ground and seals up its pores." Why this should be will be clear to every one on brief reflection. Sewage, however limpid, holds in suspension a large quantity of paper, finely comminuted, along with the fibres of linens, cottons, and woollens derived from the wash-tub, and in certain towns from manufacturing processes. This fibrous matter soon clogs up any filter, whether it be formed of paper, earth, or charcoal.

As a preparatory step to irrigation, Mr. Monson seems (p. 11) to recommend precipitation with lime. Now, all the lime processes—all modes of sewage treatment, that is, where lime is employed for any purpose save neutralising acids or acid salts—have this cardinal fault, that they expel any ammonia which may happen to be present. Hence, if it be true, as Mr. Monson expressly declares, that the most valuable part of sewage is ammonia, precipitation with lime is a capital mistake.

The pamphlet concludes with a section on artificial manures, from which we extract two passages:—"Carbon is the base of carbonic acid, and the most considerable element of the solid parts of minerals (!) and vegetables." "*Alumina* and the several varieties of clay may be regarded as silicates of alumina."

CORRESPONDENCE.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

Sir,—In reply to a question as to a statement by Dr Voelcker that soluble phosphate can be bought at 3s. 6d per unit, I will ask your correspondent to well conside the terms in which superphosphate of the best quality i supplied by the Lincolnshire Farmers' Association to its 750 members occupying 240,000 acres of land in the counties of Lincoln, Rutland, Nottingham, Huntingdon, York, Derby, Leicester. Northampton, Buckingham, Bedford, Cambridge, and Norfolk. The manure is guaranteed by Dr. Voelcker's analysis to contain 28 per cent of soluble phosphate, and is delivered *free* by rail to all its members at £3 16s. per ton. This is less than 3s. per unit; but if 15s. per ton is deducted for the value of the sulphate of lime, and 10s. per ton for carriage, it will make the actual cost of the soluble phosphate a fraction under *two shillings per unit*.

I shall be glad to supply any other information to your correspondent.—I am, &c.,

W. Little.

The Hall, Heckington.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

Sir,—I shall be obliged if you will allow me to say a few words in reply to "A Gloucestershire Farmer." He appears by a clerical error to have written £7 10s. instead of £17 10s., but Dr. Anderson's old estimate of 6s. is decidedly above the present value of superphosphates. It may be, however, that this estimate is based on the actual percentage of monocalcic phosphate; while "soluble phosphate" technically means "tricalcic phosphate made soluble." Values have advanced considerably since the close of last season, and 3s. 6d. per unit is not now an unreasonable retail price for bone phosphates, but is rather too much even for high-class mineral supers. As an example I may mention that our retail price last season at our works was about 3s. 3d. per unit for a superphosphate made entirely of bone material, and which analysed upwards of 40 per cent soluble; and about 3s. 1d. per unit for mineral 36 to 38 per cent.—I am, &c.,

Manure Manufacturer.

York, October 5, 1874.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—I am afraid your correspondent T. A. R. must have been ransacking some ancient mineralogical works, for I cannot find more than 38 minerals out of the 150 he exterminates, in any good modern mineralogical books. In the best works I only found 14, and many of these are varieties of the same mineral. I will just notice a few minerals given by T. A. R.

Beaumontite.—Considered by G. Rose to be a distinct mineral; but Alger and Dana consider it to be Heulandite. It is without doubt Heulandite. It is extremely rare, and occurs in very small crystals having a quadratic appearance. In reality the crystals are monoclinic, showing the following forms:—

The basal terminal plane, OP
The Clinopinacoid, (aPa)
The orthopinacoid, aPa
The positive ortho-dome, Pa } in equilibrium.
The positve hemipyramid, $2P$

This form looks very like the combination of the prism of the first order (aP) with the pyramid of the first (P) in the quadratic system.

Belonite.—Is a genuine mineral, crystallising in the rhombic system, in long needles. It is now called Aikenite. Its composition is as follows.

Bi	34·45
Pb	36·05
Cu	10·59
S	16·61
	100·00

Cyanolite.—Is simply Okenite.

Dopplerite.—Is a variety of brown coal. Is rightly named.

Herrerite.—Should be called *impure* Smithsonite (zinc carbonate with malachite as an impurity).

Idryl—Is now called Idrialine or Idrialite. Is a carbonaceous substance accompanying cinnabar. Is rightly named Idrialite.

Kalkoolborthite.—Exists at the present moment as Volborthite. Crystallises in the hexagonal system. Is a vanadate of copper with calcium vanadate and water.

Dumasite.—Is chlorite.

Polyhalite.—Is rightly named.

Pyromeline.—Is now called Morenosite. Is a genuine mineral. Is sulphate of nickel with water.

Zamtite.—Is now called Zaratite. Was formerly called "Emerald Nickel." Is a genuine mineral having the following composition.

NiO	58·81
CO_2	11·69
H_2O	29·50
	100·00

Mineralogy has made rapid strides within the last five years, so that a book dating 1868 is already far behind, and almost useless. T. A. R. has, however, done good service in bringing before the notice of mineralogists the absurd names which are still to be found in some mineralogical works.—I am &c.

Charles A. Burghardt, Ph.D.,
Lecturer in Mineralogy.

The Owens College,
Manchester, Oct. 6, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 8, August 24, 1874.

Ninth Note on Guano.—M. E. Chevreul.—The author announces the discovery in guano of a compound of a double chloride of ammonium and sodium, forming cubic and octahedral crystals. In his final reflections he urges that the value of a manure cannot be ascertained from its mere ultimate analysis—its proximate composition requiring also to be taken into consideration.

Passivity of Iron.—M. A. Renard.—Iron wires exposed for ten minutes to the action of nitrous vapours are not attacked if subsequently plunged into nitric acid of 30° to 40° B. Into a glass containing nitric acid of 30° to 40° B. was plunged an iron wire, one part of which remained outside the liquid, and the acid was stirred to lessen the intensity of the action. The wire was then withdrawn and re-inserted. After a few immersions the part withdrawn became passive. To obtain this result easily the wire ought to be quickly re-inserted at the moment when a very transient whitish tint appears on its surface. At the very instant when the wire becomes passive under these circumstances, there is all around it a slight gaseous covering, which may be very distinctly perceived on moving it gently in the liquid. To render an iron wire passive it is sufficient to plunge the third or fourth part of its length into mono-hydrated acid for about ten minutes, to place it in a test-glass, the bottom of which contains acid of from 30° to 40° B., and to fill up the glass with the same acid. The part of the iron which has not been immersed in the mono-hydrated acid is not attacked, and the whole wire becomes passive. To succeed with this experiment it is well to flatten with a file the end of the wire which is not to be plunged into the mono-hydrated acid. This precaution, needless with acids of 37° to 40° B., is necessary with less concentrated acids, otherwise the iron is attacked when the acid reaches this point. An iron wire plunged into common nitric acid of 30° to 40° B., after having been placed in acid of 47° B., is not attacked even if briskly stirred. It is passive, but a similar state is only permanent with acids of 37° to 40° B. Passive iron, preserved in acids of 30° to 36° B., is attacked after some days. Acids below 30° B. attack passive iron after a few hours.

Direct Combination of Chromic Acid with Wool and Silk, and its Applications in Dyeing, and in the Analysis of Wines.—M. E. Jacquemin.—Chromic acid has the power of combining directly with wool and silk, forming with them a yellow compound which resists washing and soaping. The author passes white wool into a bath at about 60° C., containing carbonate of soda to about the fifth of the weight of the wool to be dyed. Then, after washing, he introduces them into a luke-warm bath containing per kilo. of wool—

Bichromate of potassa	60 grms.
Sulphuric acid at 66° B.	60 „
Water	40 to 50 litres.

In a few minutes, at 30° C., the wools take a fine straw yellow. For darker shades they are worked for twenty minutes at a temperature which need not rise above 60° C., and then washed in abundance of water. Cotton is not dyed under the same conditions. This reaction may be used for distinguishing animal from vegetable fibres. Chromic acid when combined with wool preserves some of its characteristic properties. On treatment with cold subacetate of lead it combines with oxide of lead without leaving the animal fibre, and forming a decided chrome yellow, the tone of which differs from that produced by the acid alone. Sulphurous acid reduces it to the state of chromic oxide, which remains combined with the wool. Chromic wool has no action upon a cochineal bath. It takes up the aniline colours without sensibly modifying them, the darker shades being merely somewhat flattened. If chromic wool is boiled in fustic liquor it takes solid reseda, and with madder a catechu garnet. Orchil dyes chromic wool, but the colour is rather flat. Peachwood gives a deep wine-lees shade. Logwood gives a brown; logwood and peachwood mixed produce iron-greys, bordering upon black, and, with the addition of fustet, a good black. Chromic wool immersed in a genuine wine, no matter of what growth, and boiled for a long time, takes a characteristic light brown. Cochineal, which is sometimes used to colour sophisticated wines, has no action. The author has found that certain red caramels sold at Paris for the purpose of colouring wines owe their tinctorial power to derivatives of aniline.

Ureides of Pyruvic Acid, and on its Bromated Derivatives.—M. E. Grimaux.—This paper is not adapted for abstraction.

Analyses of Specimens of Veal, Mutton, and Pork, as Sold in the Markets of Paris in 1873 and 1874.—Ch. Mène.—A tabular view of the results of the ultimate analysis of the samples.

Action of the Sulphuretted Hydrogen of the Springs of Luchon upon Granite.—M. F. Garrigou.—The sulphuretted hydrogen liberated from the waters, and meeting with rocks, more or less permeable to air, is decomposed, furnishing different products according to circumstances, sometimes sulphuric acid and water, and sometimes free sulphur. The former change ensues where the air has free access. The sulphuric acid attacks the rocks, and forms sulphates at the expense of their soluble constituents. The felspar of the granites contains silicates of lime, soda, potash, and lithia. Cæsium and rubidium are also present.

No. 9, August 31, 1874.

Remarks on Certain Recent Researches on the Explosive Force of Gunpowder.—MM. Roux and Sarrau.—The authors point out the general agreement of the results obtained by Messrs. Noble and Abel with their own.

New Form of Prism for Direct-Vision Spectroscopes.—J. G. Hofmann.—In the author's earlier direct-vision spectroscopes the system of prisms was 10 centimetres in length. In the new pattern it is reduced to 8. The field is naturally larger, and the rays pass along the axis of the system.

Liebig's Annalen der Chemie und Pharmacie.

July 15, 1874.

Researches Carried on in the Laboratory of Beilstein, at St. Petersburg.—These include papers on certain ethereal oils, by Kurbatow (frankincense, and oil of calamus); on sulpho-propionic acid; on ethyl-sulphonic ether; and on isomeric sulpho-cinnamic acids.

Formation and Decomposition of Metallic Sulphides.—K. Heumann.—The author examines the reaction of copper and the polysulphides of ammonium; of copper and monosulphide of ammonium; of cupric oxide and monosulphide of ammonium; of copper and ammoniacal solutions of sulphides of arsenic and antimony; the changes of cinnabar on exposure to light; and the desulphurisation of silver in the moist way.

Contributions to the Knowledge of the Ammonia Derivatives of Benzol.—H. Salkowski.—This paper contains an account of dinitro-salicylic-ethyl-methyl ether $C_6H_2(NO_2)_2OC_2H_5CO_2CH_3$; dinitro-anthranilic acid, its ammonia salt, and its methylic and ethylic ether; dinitro-salicylic-dimethyl-ether, its decomposition by ammonia; the methyl-ethyl and diethyl ethers of the same acid; nitro-anisic acid, and its decomposition by ammonia; nitro-paramido-benzoic acid, and its potash, ammonia, and baryta salts; its decomposition by alkalies, and its reduction; ortho-phenylen-diamin, and its combinations with acids; the conversion of nitro-paramido-benzoic acid into nitro-benzoic acid; nitro-para-diazo-benzoic acid; the action of ammonia upon anisic acid, upon methoxy-benzoic acid, and apon methyl-salicylic acid.

Investigations into the Volume-Constitution of Solid Bodies.—H. Schröder.—This paper treats on the isosterism of NH_3 and NH_4, of CrO_3 and CrO_4, and of WO_3 and WO_4.

On Cinchonin.—H. Weidel.—An extensive essay, not adapted for abstraction.

Repertorium fur Experimental Physik,

Band x., heft 2 and 3.

Preparation of Plateau's Glycerin-Liquid, and on its Application in the Study of the Coloured Rings Produced by their Laminæ.—A. Terquem.—Some years ago Plateau described the composition and preparation of the glycerin liquid which he employed in producing the equilibrium forms shown by the surfaces of liquids withdrawn from the influence of gravitation. His method of preparation being complicated, and not always successful, the author has endeavoured to remove these objections, and produce a glycerin-fluid of constant composition, whatever may be the nature of the soap employed. He avails himself of the circumstance that the oleates are more readily soluble in alcohol than the stearates. He takes Marseilles soap, and reduces it to shavings with a plane in order to dry it the better. If these shavings are exposed to the sun in summer, or laid on a stove in winter, they are perfectly dry in a few hours. They are then put in a bottle with alcohol of 80°. The specific gravity of such alcohol is 0·865, and, if saturated with soap at the temperature of 15° C., it marks 74 on the centigrade alcoholometer. Its specific gravity is then 0·880, and 10 c.c. contain 0·742 grm. of soap. The solution of the soap must be effected in the cold. At higher temperatures much more soap is dissolved, and the result is, on cooling, a solid mass. In the meantime a mixture of glycerin and water is prepared, in such proportions as to mark 17·1° B., =sp. gr. 1·35 at 20° C. This represents a mixture of equal volumes of water and of the most concentrated glycerin. The bottle containing the mixture of glycerin and water may be advantageously heated with boiling water to prevent the development of confervæ. To prepare the final mixture take 100 c.c. of the diluted glycerin, and add 25 c.c. of the alcoholic soap solution. The liquid is liable to become turbid if the glycerin contains sulphate of lime. In order to expel the alcohol, the mixture is then brought to a boil until its point of ebullition rises to 100° C. It is then allowed to cool, poured into a graduated glass, and made up to 100 c.c. with distilled water. It is then repeatedly filtered to remove any oleate of lime which may have been formed. The filtration is tedious, and may require to be several times repeated. The uses of this liquid, in the performance of Plateau's experiments, are next described. This portion of the paper is useless without the accompanying engravings.

Apparatus to Demonstrate the Propagation of Sound in Gases.—A. Terquem.—Unintelligible without the illustration.

A Variation Barometer.—F. Kohlrausch.—The author describes and figures the method of preparing a barometer combining unlimited sensitiveness with total freedom from friction.

Approximate Conditions of Reflection and Refraction for the Main Section of Moving Media.—E. Ketteler.—Not adapted for abstraction.

Specific Law of so-called Anomalous Dispersion.—E. Ketteler.

Specific Heat of Carbon.—Carl Puschl.—The diamond is more abundantly permeated by invisible heat rays the lower the temperature of their source. In other words, its opacity for invisible heat rises with the temperature of the source.

Simultaneous Movement of Light in Moving Media.—Carl Puschl.—Not adapted for abstraction.

The Air Thermometer.—P. Jolly.—This paper, again, is useless unless accompanied by an engraving.

Reduction of the Degrees of Intensity Given by the Anemometers used in Switzerland and Baden to the Actual Velocity of the Wind.—Dr. G. Lübeck. This paper also requires diagrams.

Determination of the Freezing-Point for Delicate Thermometers.—Dr. G. Krebs.—Schultz, in his treatise on the freezing-point of the water of gaseous solutions and the regelation of ice, shows that the freezing-point of water is lowered by dissolving gases, the change being nearly proportional to the amount of gas dissolved. That water holding solids in solution freezes at a lower point is well known. Thomson and Clausius have shown from the principles of the mechanical theory of heat that the freezing-point of water falls 0·007° C. for every additional atmosphere of pressure. To determine the true freezing-point, take a glass tube closed at one end, 20 centimetres long and 2 wide, fill it almost full with sulphuric acid, and heat. Then pour out the acid, and rinse repeatedly with pure distilled water. The tube is then two-thirds filled with distilled water, which has been boiled for some time in a clean beaker, and a small quantity of filtered oil of turpentine (about 1 centimetre in depth) is poured upon the water. The tube is then carefully heated in the oil-bath, without allowing the temperature to rise to the boiling-point lest an explosion should ensue. The object of the heating is to remove any air bubbles which may adhere to the side of the glass, or may remain between the turpentine and the water. When the water has been thus exposed for a considerable time to a temperature very near to the boiling-point, the tube is taken out of the oil-bath, cooled in cold water, and then placed in a freezing mixture (water and nitrate of ammonia). After a few minutes the water is cold, and in most cases a portion of it freezes at once if a thermometer is inserted, and moved up and down. If this does not take place the tube must be returned to the freezing mixture, and cooled more strongly. The thermometer may be previously placed in an empty test-tube, which is then plunged in the freezing mixture. It is very important that the thermometer should be cooled down close to the freezing-point before being introduced into the water. The best thermometers when tested in this manner show a freezing-point too high by about 0·1° C.

Soldering Platinised Glass.—Dr. W. C. Röntgen.—The platinised glass is well cleaned, slightly heated to prevent the glass from flying, coated with the flux (chloride of zinc), and tinned with the soldering iron. Care must be taken not to bring this tool too much in contact with the platinum coating, as the latter otherwise becomes too thoroughly alloyed with the zinc, and disappears from the glass. When the glass is tinned over it is ready to be soldered to any metal.

A Modification of the so-called Poison Syphon.—A. Weinhold.—Gawalowski describes a syphon for volatile dangerous liquids without exposing the mouth of the operator. The author describes an improvement, which, however, cannot be understood without the accompanying figures.

Conversion of Common into Amorphous Phosphorus.—Von Schrötter.—A description of several apparatus for effecting this conversion. The change is produced by electricity, and not by heat or light accompanying the current.

Moniteur Scientifique, du Dr. Quesneville, August, 1874.

Theory of the Formation of Nitre in Peru.—Antony Guyard.—The nitre districts of Peru form a plateau of a mean elevation of 3000 feet, 15 to 20 leagues broad, and several hundred leagues in breadth. The author supposes that there has been an epoch when nitrogen compounds were disengaged from the volcanoes, just as there were sulphuric, hydrochloric, and boracic epochs. The alkali is derived from the decomposing porphyritic mountains, which have also given rise to the beds of kaolin and other clays. In general, the saltpetre exists in the form of saccharoid barks, formed principally of nitrate of soda and chloride of sodium, mixed with nitrate and iodate of potash, chlorides of magnesium, aluminium, and calcium, sulphates of lime, magnesia, and alumina. The earthquakes of these regions he considers to be subterranean electric storms. The author opposes the view that the nitre beds are derived from decomposed guano, and the iodates from sea-weeds. He has already shown that the colouring matters of the nitre beds are not of organic origin, the yellow being chromic acid and the violet manganic.

On Lupuline.—Dr. Griessmayer.—An interesting paper, but unsuited for abstraction.

Industrial Preparation of Chloride of Lime.—A controversy between M. Gœpner and MM. Richter and Junker.

Manufacture of Artificial Butter in America.—An account of various processes—now sufficiently notorious—for making butter from the fat of cattle.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.

Pyrogallol in Presence of Salts of Iron.—M. E. Jacquemin.—In presence of organic ferric salts pyrogallol does not behave as with mineral ferric salts. It produces a blue soluble in water, and permanent for some days. Ferric sulphate and perchloride, if treated with a slight excess of an organic salt of an alkali or an alkaline earth, acquires also the property of yielding a permanent blue with pyrogallol. The action of ammonia upon the pyrogallo ferric chloride is so sensitive that 1 grm. of perchloride of iron is enough to colour 2 hectolitres of water a reddish purple. Hence every substance which can change the reddish brown ferric pyrogallol to a blue, a violet, or a reddish purple may be ranked among the alkalies or alkaloids. Hence we have a simple means for distinguishing alkaloids from glucosides. To prepare the reagent it is necessary to add very little ferric chloride to the pyrogallol, since a slight excess of the latter is not hurtful. An alcoholic solution may be used if the substance be insoluble in water. The alkaloid, even if solid, turns blue in contact with the pyrogallo ferric chloride, whilst glucosides produce no change of shade.

Albumenoid Bodies.—M. A. Commaille.—The substance of this paper has been already noticed in the Chemical News.

Part Played by Salts in the Action of Potable Waters upon Lead.—M. Fordos.—The author finds that sulphate of soda, chloride of sodium, chloride of ammonium, nitrate of potash, nitrate of ammonia, sulphate of lime, and sulphate of magnesia do not hinder the joint action of water and atmospheric carbonic acid upon metallic lead, and that traces of the lead remain in solution.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 9, September, 1874.

There is no chemical or physical matter in this number. The paper on the phosphatic deposits of Calvados treats merely of the extent and distribution of the phosphate beds, without any reference to chemical or mineralogical considerations.

Reimann's Farber Zeitung, No. 35, 1874.

This number contains receipts for a brown and a dark nacarat on cotton yarn; a description of a new wringing machine, and of a rinsing machine; a continuation of the directions for dyeing with aniline colours; a test for ultramarines as regards their value for blueing white grounds, the sample being preferred which, when diffused in water, attaches itself best to a swatch of white calico hung up in the liquid.

Methyl violet has been recommended as an indication for acids in place of litmus; it is not, however, affected by acetic acid.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 17, 1874.

Determination of Lead in Ores.—Lowe, having observed that the aqueous solution of hyposulphite of soda is capable of dissolving sulphate of lead, proposes to utilise this reaction for removing this salt from stony residual matter. Such residues, perfectly washed and separated from the filter, is stirred up in a suitable vessel with a cold concentrated solution of hyposulphite of soda. It is allowed to settle for some time, washed by decantation, and the residue stirred up afresh with a further quantity of the same solution. This operation having been repeated two or three times, the solutions are mixed together, and the lead is separated by means of sulphuretted hydrogen or hydrosulphate of ammonia. The sulphide of lead thus obtained is further treated in the usual manner.

Poison of Nettles.—M. C. Naudin maintains that after a violent wind the sting of the nettle is deprived of its virulence.

Tome xxxv., No. 1, September 3, 1874.

Lippmann's Electro-Capillary Motor.—This paper would be unintelligible without the accompanying illustration.

Photography at the Bottom of the Sea.—Dr. Neumayer has recently presented to the Geographical Society of Berlin a photographic apparatus destined to determine the temperature and the currents at great depths in the ocean.

Atmospheric Corpuscules.—M. Lamey.—The author holds that the "luminous particles," which M. F. Anderson describes as seen in a pure atmosphere near the sun, have no objective existence, and must be regarded as a physiological phenomenon.

No. 2, September 10, 1874.

Means of Banishing Weevils from Granaries.—M. A. Flament.—It has been observed that a few bundles of raw hemp completely expels these destructive insects from a granary.

New Eudiometer.—M. A. Dupré.—This paper should have been accompanied by a diagram.

Bulletin de la Societe Chimique de Paris, tome xxii., No. 1, July 5, 1874.

Action of Ammonia upon Phenyl and Cresyl Chloracetamid.—M. D. Tommasi.—This paper has been already noticed.

On Fluoxyboric Acid.—M. A. Basarow.—The author concludes that fluoxyboric acid is not a homogeneous body, but merely a solution of boracic acid in hydrofluoboric acid.

Action of Bisulphide of Carbon on Benzoin, the Balsams, and the Resins.—M. P. Guichard.—A pharmaceutical paper on the solubility of drugs.

Iodide of Ethyliden.—M. G. Gustawson.—The iodide of ethyliden yields with alcoholic potash the same product as the iodide of ethylen, *i.e.*, iodide of vinyl. These results do not agree with those of Semenoff, who obtained a body isomeric, but not identical with, iodide of vinyl.

Determination of a Mixture of Sulphides, of Sulphuretted Hydrogen, and of the Hyposulphites.—M. Schlagdenhauffen.—A valuable paper; too long for insertion.

Identity of Bromoxaform and of Pentabromated Aceton.—M. E. Grimaux.—This paper has been already noticed.

On Soluble Starch.—M. Musculus.—Already noticed.

Modification of the Blowpipe.—M. A. Dupré.—An improvement on Luca's blowpipe. Its construction, in the absence of an illustration, is difficult to understand.

Facts Observed in the Study of Sugar.—E. J. Maumené.—A reconstruction of the tables drawn up for ascertaining the value of saccharine solutions by means of their sp. gr.

Process for Determining Tannin in Wines, and on the Experimental Stations in Italy.—E. J. Maumené.—A known volume of the wine is measured out, and alcohol is added in moderate quantity. An excess of solution of caustic baryta is added, then a little sal-ammoniac. The mixture is heated for some minutes, cooled, and the precipitate washed first with concentrated alcohol and then with cold water. The tannic precipitate is then treated with dilute boiling sulphuric acid, and the tannin in the solution is determined by permanganate of potash.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

A new medicinal compound, and plasters made therewith. John McIntyre Smith, New York. (A communication from Dr. Paul Edmond Audouit, surgeon, Havre, France.) January 23, 1874.—No. 297. One of the most important uses of the compound and of the plasters is to prevent sea-sickness. The following is a description of what is considered the best means of carrying out the invention:—Take of what is known as diachylon (in French, *emplaytre de diachylon*), sometimes called court-plaster (an oxide of lead and oil), 2 grms. With this thoroughly mix 2 grms. of theriac, or Venice treacle (in French, *theriaque*), and 1 grm. of extract of belladonna (in French, *extrait belladonne*), and preserve the compound in a tight stoppered vessel. To use the compound as a preventive or cure for sea-sickness, spread it to about the thickness of an ordinary adhesive plaster on a small oval piece of kid or other soft leather. One of these plasters being slightly warmed is applied and caused to stick on the pit of the stomach. Thin muslin paper, thin vegetable parchment, and various other substances may be used with success, instead of leather, as a foundation for the plaster.

An improved composition or material to be used in lieu of coal for fuel. Edwin Lowe, coal dealer, Birmingham, Warwick. January 26, 1874.—No. 326. I propose to collect the dry sewage out of the streets or ashpits, or other equivalent accumulations of dry matter, and having driven out any remaining moisture therein, to grind it in a mill or by other suitable means to a proper degree of fineness. I then mix with the said dry matter a proper proportion of (1) gas-tar, (2) charcoal, (3) coal slack, (4) clay washings; and the whole being well mixed together, is then compressed into moulds of a suitable size, and then dried and allowed to acquire a hard consistency, when it is ready for use as fuel. The improved fuel as thus produced can be used for any purpose where fuel is required. Thus, it may be employed either for blast-furnaces or for domestic use, being equally serviceable in either case, but the relative proportions of the ingredients to be mixed with the dry sewage matter is altered as required to suit the draught or fire where the material is destined to be employed.

Improvements in the manufacture of sulphuric acid. Henry Glover, Bow, Middlesex. January 27, 1874.—No. 346. This invention relates to improvements in effecting the concentration of weak sulphuric acid, such, for example, as that known as chamber acid or brown acid, so as to produce or manufacture sulphuric acid of commerce; and consists in effecting such concentration by means of highly-heated air or gases which are not acted upon by sulphuric acid; and causing such heated air or gases to be forced through, and be brought in contact with, the acid to be concentrated by preference in the form of finely-divided streams or currents.

Improvements in the manufacture of bicarbonate of soda. James Richards, chemist, Clifton Lodge, near Preston. January 29, 1874.—No. 376. My invention consists in treating bicarbonate of soda by a dilute solution of caustic ammonia, which decomposes the bicarbonate of ammonia, thus forming carbonate of ammonia, which is easily removed by washing.

Improvements in the manufacture of alloys of iron. Alexander Browne, of the firm of Browne and Co., patent agents, Southampton Buildings, Holborn, Middlesex. (A communication from the Foundries and Forges Company, of Terre Noire, La Voulte, and Bessèges, France.) February 2, 1874.—No. 422. The features of novelty of this invention consist of improvements in the manufacture and treatment of alloys of iron with manganese, tungsten, titanium, silicium, and other like substances: and is comprised under the following heads:—First. In methods of preliminary treatment of the materials used by combining them previous to the operation of smelting. Second. In the adoption of specific proportions of materials with a view to the production of definite alloy. Third. In collecting the alloy thus produced in the most economical manner; and this is accomplished by a double process, that is to say—(1) Rendering the slag or cinder perfectly fluid; (2) by subsequent additions of metals or alloys to cause a union of the scattered portions into one mass. To fully understand the whole course of the operation it is necessary to refer to the Specification.

Improvements in the manufacture of gum and gum-like substances from linseed oil and other similar oils. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Donald D. Cattanach, Providence, Rhode Island, U.S.A.) February 2, 1874.—No. 423. This invention consists in the manufacture of a gum or a gum-like substance from linseed oil or kindred oils by a process of treatment involving mainly the exposure of the oil to air and light, accompanied by frequent and continued agitation or stirring of the oil during such exposure, with or without a preliminary purification of the oil so treated.

The incineration of mixed vegetable substances from wools or woollen fabrics by the application and manufacture of chloride or chlorate salts, preferably of zinc, magnesium, and aluminium, applicable to unbleached and dyed or coloured materials.—Edward Griffith Brewer, Chancery Lane, Middlesex. (A communication from Romain Joly, Caudebec-lès-Elbeuf, France.) February 3, 1874.—No. 433. This invention consists in the incineration of vegetable matters contained in wool or woollen fabrics by means of chlorides or chlorates of zinc, magnesium, and aluminium, and in the manufacture of the latter product.

TO CORRESPONDENTS.

Errata.—In No. 767, p. 57, col. 2, line 24 from top, *for* 5 hours *read* 2 hours; line 25, *for* 10 hours *read* 4 hours.

W. C. P.—No.

J. G. Laurie.—Perhaps Johnson and Matthey, of Hatton Garden, could supply it; we do not know.

J. H. J. R.—Order of any foreign bookseller.

THE CHEMICAL NEWS.

Vol. XXX. No. 778.

ON COLOPHTHALINE AND COLOPH-ALUMINA.

By PAUL CURIE.

Under the above names I purpose to describe a solid hydrocarbon and a new organic base prepared from common resin (colophony). Among the last products of the destructive distillation of resin there is found, in comparatively small quantities, a solid hydrocarbon which has been generally spoken of as naphthalin, and has therefore not attracted to any considerable degree the attention of chemists. This is *Colophthaline*.

When, instead of submitting resin to a slow distillation, such as is practised in the manufacture of "resin oils," it is decomposed rapidly at a red heat, the liquid products, or "oils," are reduced to a minimum, gases are produced in large quantities, and the proportion of colophthaline is greatly increased; but this solid hydrocarbon can be obtained more readily, and in still larger proportions, by the following process:—

100 parts of resin and 50 parts of sulphur are heated together in a retort at a temperature which can gradually be raised to about 200° C. The reaction begins at about 150° C.; sulphuretted hydrogen is evolved in abundance, and also a small quantity of water, which distils, and represents the loss, under that shape, of the oxygen of the resin, $C_{20}H_{16}O_2$. When the temperature has reached 200°, and no more HS is disengaged, the substance in the retort has the appearance and composition of a resin in which O is replaced by S. No further reaction takes place until the heat be carried to about 400° C.; a fresh quantity of HS is then produced, and at the same time the hydrocarbon colophthaline distils, together with a small quantity of a liquid of equally high boiling-point. The quantity of colophthaline thus obtained reaches, after purification, about 30 per cent in weight of the resin employed. The same results are obtained by the action of sulphur on terebene, colophene, or on common resin oil, instead of colophony itself. This process has enabled me to prepare large quantities of colophthaline with the greatest facility and in a form admitting of easy purification. I will now proceed to describe some of the principal properties of this hydrocarbon, which, as will be seen, has but a very distant resemblance to naphthaline, and is the source of at least one very remarkable body.

Colophthaline is easily soluble at the ordinary temperature in benzol, naphtha, spirits of turpentine, carbon bisulphide, and ether; it is dissolved by alcohol and glacial acetic acid at their boiling-point only, and is deposited again on cooling. The liquid products with which colophthaline is mixed being much more easily soluble in alcohol, this substance can by this means be completely freed from them. Thus purified, colophthaline is a flocculent white body, possessing a slight balsamic odour. Its melting point is at 70° C., and, when melted, its colour becomes brown; it boils at about 400° C. It is composed of—

Carbon	93
Hydrogen	7
	100

which numbers correspond to the formula $C_{22}H_{10}$.

Oxidising agents, chlorine, and nitric acid, attack colophthaline with the greatest facility, and form the following compounds:—

Oxicolophthaline, a fine orange-yellow crystalline substance, slightly soluble in cold alcohol; completely soluble in boiling alcohol, ether, bisulphide of carbon, &c.; insoluble in alkaline solutions; not volatile; decomposable by heat; prepared by dissolving colophthaline in boiling glacial acetic acid, and adding thereto about three times its weight of chromic acid dissolved in acetic acid, or bichromate of potassa in sulphuric acid. When the reaction is terminated, the oxicolophthaline is in solution, but on cooling down the liquid, or adding thereto 2 volumes of water, this substance separates; it must then be collected on a filter, washed, and purified by crystallisation from alcohol. Composition, $C_{22}H_8O_2$.

Chloro-Colophthaline, $C_{22}H_8Cl_2$; this is a viscous greyish yellow body, obtained by gently warming colophthaline with chlorine, or with chlorate of potassa and hydrochloric acid. When prepared from dry chlorine, the reaction takes place with great energy, brilliant flashes of light being evolved, and the product partly decomposed.

Nitro-Colophthaline is prepared by heating the hydrocarbon with nitric acid until it is entirely dissolved therein. On cooling, the nitro-colophthaline precipitates. It is an ochre-coloured, resinous, non-volatile, and uncrystallisable substance; slightly soluble in dilute acids; completely so in concentrated acids, and in ether, benzol, bisulphide of carbon, &c.; it melts at 100° C., but a higher temperature decomposes it. Caustic alkalies dissolve nitro-colophthaline; on boiling the solution, it loses its nitrogen in the shape of ammonia, and the liquid, which is then of a yellowish brown colour, contains, in combination with the alkaline base, a substance which can be precipitated in brown flocculæ by the addition of an acid. This I shall call *Coloph-Ulmic Acid*, on account of its properties closely resembling those of ulmic acid.

Now the substances above described as oxi-, chloro-, or nitro-colophthaline, and coloph-ulmic acid, all undergo a most remarkable reaction when fused with hydrate of potassium. They are transformed into a white amorphous body of decided basic properties, having so nearly exactly the appearance of alumina that it might be easily mistaken for that metallic oxide. For this reason I claim for this new substance the name of *Coloph-Alumina*, and I will now proceed to enumerate some of its extraordinary characteristics.

Coloph-Alumina having been prepared in the manner above described, the fused alkaline mass is dissolved in dilute hydrochloric acid, in which solution ammonia forms a voluminous precipitate of hydrate of coloph-alumina; this white gelatinous precipitate being washed, and left to dry spontaneously, loses the greater part of its water, and shrinks gradually into a compact, hard, stony-looking mass, which still retains 1 equivalent of water, and only loses it at a high temperature. Coloph-alumina is insoluble in all neutral liquids—water, spirits, ether, &c.; it is infusible and non-volatile; it resists the action of all oxidising agents, though at a high temperature, and *is not decomposed even at* 1000° C. by chlorate or nitrate of potassa! Owing to the difficulty of decomposing coloph-alumina, it has been found impracticable to effect its analysis by any direct method; its chemical composition, however, as deducted from the mode of its formation, appears to be represented by $C_{20}H_6O_4$.

The basic properties of coloph-alumina are not very energetic. Nevertheless hydrochloric, nitric, acetic, and oxalic acids dissolve the base with ease, but the salts thus formed have not been obtained otherwise than in solutions, as by concentrating the liquor the base and the acid are too easily dissociated.

Concentrated sulphuric acid does not merely *dissolve* coloph-alumina; heated to about 200° C., it substitutes SO_3 to H, and forms a compound which is amorphous and nearly insoluble in water—*Sulpho-Coloph-Alumina*, probably $C_{23}H_4(SO_3)_2O_42(HO)$; a red heat merely regenerates coloph-alumina from this.

Chloro-Coloph-Alumina is also a substitution compound obtained by heating coloph-alumina to redness in a porcelain tube through which passes a slow current of dry chlorine; HCl is disengaged, and the resulting product, $C_{20}H_4Cl_2O_4$ is a white, non-volatile, insoluble powder,

Google

fusible at a very high temperature. Sulphur has no action whatever on coloph-alumina, but a sulphide can be prepared by the same process as that used for the production of sulphide of aluminium, viz., by sending vapours of bisulphide of carbon over red-hot coloph-alumina; this sulphide is insoluble in water, and attacked by acids with disengagement of HS.

Coloph-alumina, as I have already said, resists the direct action of oxidisers, but a combination with oxygen is obtained by acting on the substitution compounds, sulpho- or chloro-coloph-alumina; these, being fused with caustic potassa in excess, exchange their SO_3 or Cl for O. The new body thus formed is an acid—*Coloph-Aluminic Acid*—which remains in combination with the alkali in excess, according to the reaction—

$$C_{20}H_4Cl_2O_4+4KO.HO = 2(KCl)+2HO+2(KO)C_{20}H_4O_6.$$

The coloph-aluminate of potassa while fused is of a fine "turquoise"-blue colour. Unfortunately coloph-aluminic acid cannot be obtained separated from its alkaline combination; the mere action of water destroys it, regenerating coloph-alumina with loss of oxygen.

Such are the principal facts relating to these new bodies on which I believe it is of some importance to call the attention of chemists in general. I have only indicated here one source of production of coloph-alumina, but, from certain recent experiments, I have reasons to believe that it can be obtained from various other substances, and by other means than those here mentioned. At all events I have already ascertained that coloph-alumina is invariably the ultimate result of all energetic oxidisations of common resin, and perhaps of most kinds of resins. It might therefore frequently exist ready formed in the organs of certain plants, and be mistaken for alumina in analysing their ashes; such an error would no doubt inevitably occur in presence of a hitherto-unknown organic base having the extraordinary property of being undecomposable by a red heat.

ON THE TESTING OF CRUDE ANTHRACEN

By R. LUCAS.

As "crude anthracen" is at present sold by two different tests, the "bisulphide of carbon" test and the "anthraquinon test," it may be interesting for some of your readers to have comparative results of both tests.

The following tests were made of twenty samples of crude anthracen from eight different English manufacturers:—

No. of Sample.	Percentage of Anthracen. By Bisulphide Test.	Percentage of Anthracen. By Anthraquinon Test.	Difference.
1.	9·20	11·90	+ 2·70
2.	16·00	16·40	+ 0·40
3.	24·50	26·10	+ 1·60
4.	34·00	27·80	− 6·20
5.	35·00	28·20	6·80
6.	38·00	29·67	8·33
7.	38·00	33·38	4·62
8.	40·50	38·00	2·50
9.	43·00	33·80	9·20
10.	49·00	34·24	14·76
11.	57·40	44·51	12·89
12.	58·00	41·50	16·50
13.	59·00	44·51	14·49
14.	59·50	39·37	20·13
15.	60·00	37·66	22·34
16.	60·00	42·80	17·20
17.	64·12	48·79	15·33
18.	65·00	47·08	17·92
19.	67·00	46·22	20·78
20.	73·00	49·22	23·78

consider the anthraquinon test the only reliable test or the valuation of anthracen, because the product obtained by the bisulphide of carbon test is not "pure anthracen," but only a mixture containing variable quantities of pure anthracen. A portion of the anthracen contained in the crude sample is dissolved by the bisulphide of carbon during the test (often one-fourth of the whole anthracen). To prove this, I give a few analyses of bisulphide of carbon test residues:—

1.	Product of CS_2 test (= 100 by CS_2 test)	gave	49·64	p. ct. pure anthracen by anthraquinon test.
2.	" "	"	53·92	" "
3.	" "	"	55·64	" "
4.	" "	"	56·00	" "
5.	" "	"	59·06	" "
6.	" "	"	60·00	" "

And I add the complete tests of two samples of crude anthracen by the bisulphide and by the anthraquinon test, to show the solubility of anthracen in bisulphide of carbon by the CS_2 test:—

(*a*). The sample gave 65 per cent anthracen by the CS_2 test, and 47·08 per cent by the anthraquinon test.

The insoluble in CS_2 gave 49·64 per cent pure anthracen.
" soluble " " 42·37 " " "
Or—
65 insoluble of 49·64 p. ct. pure anthracen = 32·26 anthracen
35 soluble " 42·37 " " " = 14·82 "
100 47·08

Therefore 14·82 of anthracen out of 47·08 in sample were dissolved by the bisulphide of carbon.

(*b*). Another sample of crude anthracen gave 64·12 per cent anthracen by CS_2 test and 48·79 per cent pure anthracen by the anthraquinon test.

The insoluble in CS_2 gave 59·9 per cent pure anthracen.
" soluble " " 28·96 " " "
Or—
64·12 insoluble of 59·90 p. ct. anthracen = 38·40 anthracen.
35·88 soluble " 28·96 " " = 10·39 "
100·00 48·79

10·39 anthracen, out of 48·79 in sample, were dissolved in CS_2.

As some objections have been raised against the correctness of E. Luck's anthraquinon test, I have submitted this test to an examination, and my experiments only confirm Luck's statements, viz., that chemically pure anthracen (which is very difficult to obtain from crude anthracen) yields, by oxidation with chromic acid, really the theoretic quantity of pure anthraquinon, and that all admixtures of crude anthracen consisting of products of distillation of coal are, by all well-conducted oxidations, either destroyed or transformed into substances which are soluble in dilute alkali. I have experimented on the following admixtures of crude anthracen.—Naphthalin, acenaphthen, phenanthren, carbazol, pyren, chrysen, and benzerythren. All these tar-products submitted to the anthraquinon test were transformed into substances soluble in dilute alkali.

When 10 grms. of chromic acid were used for the oxidation of 1 grm. of crude anthracen, I found that from some samples the anthraquinon was not quite pure, through insufficient oxidation, but by increasing the chromic acid to 15 grms. per 1 grm. of crude anthracen, and boiling for 3 hours, I have always obtained pure anthraquinon as the result of the test.

ON BISMUTH BROMIDE.

By R. W. EMERSON MACIVOR.

THE combination of metallic bismuth with bromine to form "$Br'''Br_3$ is not, as is the case with antimony and arsenic, attended with the emission of light. The compound is prepared by heating finely-powdered bismuth with dry bromine in a hand-glass tube closed at the end.

Bismuth bromide, as obtained by this process, is a solid substance of a dark grey colour, fusing at a temperature of 198° to 202° C. to a dark red liquid which boils below a dull red heat. It is insoluble in carbon disulphide, alcohol, and ether. Hydrochloric acid dissolves it. By heating with nitric acid it is decomposed. It absorbs dry ammonia gas, with formation of a black non-crystalline solid body possessed of an extremely irritating smell. On exposure to the air, it absorbs moisture, and becomes of sulphur-yellow colour. Upon treatment with water it is decomposed, the products of the action being a white amorphous oxybromide and free hydrobromic acid. The oxybromide is insoluble in a solution of tartaric acid, and is decomposed on subjection to a long-continued process of washing with water, with formation of hydrobromic acid and bismuth oxide ($''Br_2''O_3+XAq$).

Glasgow, 1874.

LABORATORY NOTES.

By GEORGE FOORD.

(1). *The Facile Use of Hydrofluoric Acid for the Decomposition of Natural and Factitious Silicates.*

If an illustration were required for showing the great value of hydrofluoric acid, as a facile means for the solution and analysis of silicated compounds, perhaps no more striking example could be instanced than that described by Professors Kirchoff and Bunsen in their first paper on spectrum analysis, in which it is shown how a few grains of any mineral of the felspathic type, decomposed by hydrofluoric acid, and afterwards evaporated with excess of sulphuric acid, yields, on addition of water, a solution of the bases of the silicate, in which, if present, the potassium, lithium, sodium, strontium, barium, and calcium are readily recognisable in the spectroscope.

In expressing myself on this point, concerning the use of hydrofluoric acid, I feel that I ought to do so with great diffidence, as far, at least, as the arrangements and practice at present existing in the old country are concerned, having been so long absent from the latter; but, if I am correctly informed, the known danger of allowing the ordinary commercial hydrofluoric acid to come in contact with the skin still militates against its employment with that freedom which its usefulness would otherwise warrant.

A simple contrivance which I have employed for several years has brought the use of the acid so safely and completely under control that I have at last arrived at the view of its possible acceptability to others, and I therefore venture to describe it and suggest its adoption.

The proposed appliance is an addition to the ordinary gutta-percha bottle, in which the commercial hydrofluoric acid is commonly supplied, converting the vessel into a burette, from which the acid may be poured with precision, drop by drop, or in a thin stream, until the whole charge of the bottle is exhausted. The burette-piece is formed out of gutta-percha tube, of a diameter sufficiently small for entering easily into the neck of the gutta-percha bottle. For making it, about 2½ inches of such tube of, say, about ½ an inch external diameter is cut off, and slit down in such a manner as to remove two wedge-shaped segments from either side of its diameter. A cylindrical piece of wood (the small end of an ordinary wooden penholder is suitable), of about 3/16ths of an inch diameter, is now provided, and placed within the cut end of the tube, which latter is warmed and softened before a stove, and the two cut edges pressed together give to the tube a conical upper termination. A welt of gutta-percha, softened and applied round the warmed tube a little below the base of the conical portion, forms a flange for fitting down against the spreading top of the bottle neck. The cone is now warmed and carefully bent over to an angle of about 130° with the vertical portion, and, when cold and rigid, with a cork-cutter a circular perforation is made at the upper side of the bend. A piece of the same ½ inch gutta-percha tube, say, ¾ of an inch long, is now to have a wedge-shaped piece cut out through nearly its whole length, and, after warming, the cut surfaces are to be brought together and caused to unite so as to form a slightly conical tubulus the smaller end of which is to be warmed and applied, in the soft state, to the slightly-warmed opening at the bend of the larger coned tube. A stopper may now be made by cutting open about an inch of the same gutta-percha tube, softening and rolling it upon itself, shaping the lower end, and flattening and flanging the upper portion.

Fig. 1.

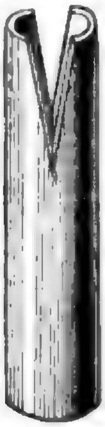


Fig. 2.

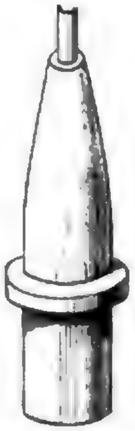


Fig. 3.

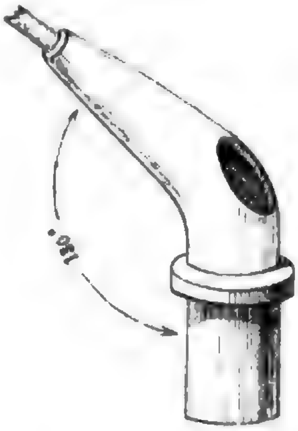
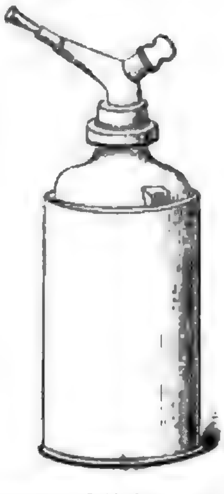


Fig. 4.



A piece of stout platinum foil is now to be rolled upon a wire of about ⅛th of an inch diameter, so as to form a platinum tube, which may readily be soldered by a thin strip of fine gold foil laid on the joint and sharply heated before the mouth of the blowpipe. This platinum tube is to be pushed into the coned opening of the gutta-percha burette-piece, and caused to adhere to it by gentle warming; the piece itself is to be adapted to the bottle by a layer of wax, kneaded until soft and pressed under the flange. The whole is pressed together, employing a warm spatula. if necessary, so as to secure a thoroughly good joint. Similarly, the stopper is fixed in with an interposed layer of wax; and a ball of wax, or little rod of gutta-percha or vulcanite, may be used for closing the tubulus when the vessel is set aside. A loose outer cylindrical case of tin-plate, reaching up to the shoulder of the gutta-percha bottle, with a cork wedge for fixing the latter, makes the arrangement completely secure, and the vessel as thus mounted can be used from day to day with the same facility as any other reagent bottle; a single drop of hydrofluoric acid can at any moment be obtained. The stopper allows access to the interior without disturbing the joint at the neck, although it may be added that after once fixing I have never yet found it necessary to remove this stopper.

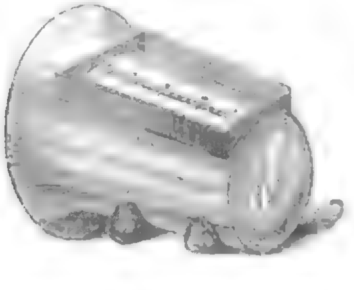
(2). *Etching Glass Vessels.*

A few sentences concerning the use of hydrofluoric acid for etching chemical vessels in the laboratory may not be out of place here. Our beakers used in the gold assay for the "parting," when the number of assays is small, as well as pipettes and similar instruments, are readily etched by use of the above-described burette. Take the example of beakers; say twenty of them are required graduated for water ounces. Upon each is pasted a vertical strip of paper, and the graduations are marked on these strips with pencil, employing a flexible strip of metal as a rule. The beakers are next painted over the surfaces to be etched, at the side of the paper temporary scale, with a suitable varnish (photographer's black varnish, which is a solution of asphaltum in benzol, with mechanically-suspended vegetable black, answers the purpose fairly, and has the advantage of rapidly drying). When the varnish is dry, vertical lines are ruled through it, and the graduations are ruled across from the paper scale, marking them in through the varnish, which operation is assisted by placing a white tile or paper under the vessel, so as to illuminate the markings from behind. The figures are now drawn in, and the vessels thus prepared are ready for bordering and etching.

The cement for bordering is made by dissolving resin in oil, and adding bees'-wax—the resin and bees'-wax in about equal quantities, and the olive oil in quantity sufficient for bringing the mixture, when cold, to about the consistence of tallow. When the fused mass has become cold, plaster-of-paris is kneaded in until the whole acquires a convenient plastic condition. The cement adheres less to the fingers after addition of the plaster; it can be softened at any time by kneading, and when pressed on to the glass surface it readily adheres to it. For the etching, the paper graduations are scraped off the glass, and rolls of the above cement are pressed on to the varnished glass surface, so as to enclose, without covering up, the lines and figures.

All the vessels thus prepared are now laid down, so as to present the portion to be etched in a horizontal position. Three or four balls of the cement pressed against the sides of each vessel support it steadily, and at the same time admit of delicate adjustment for level. The hydrofluoric acid is now poured on to each vessel from the burette, and any air bubbles in the lines and figures are removed by means of a camel-hair pencil. Powdered fluor-spar may now be dusted on, so as to form a magma with the acid; its use is purely mechanical and precautionary, the chance of leakage through any defect of the bordering being reduced by this addition.

Fig. 5.

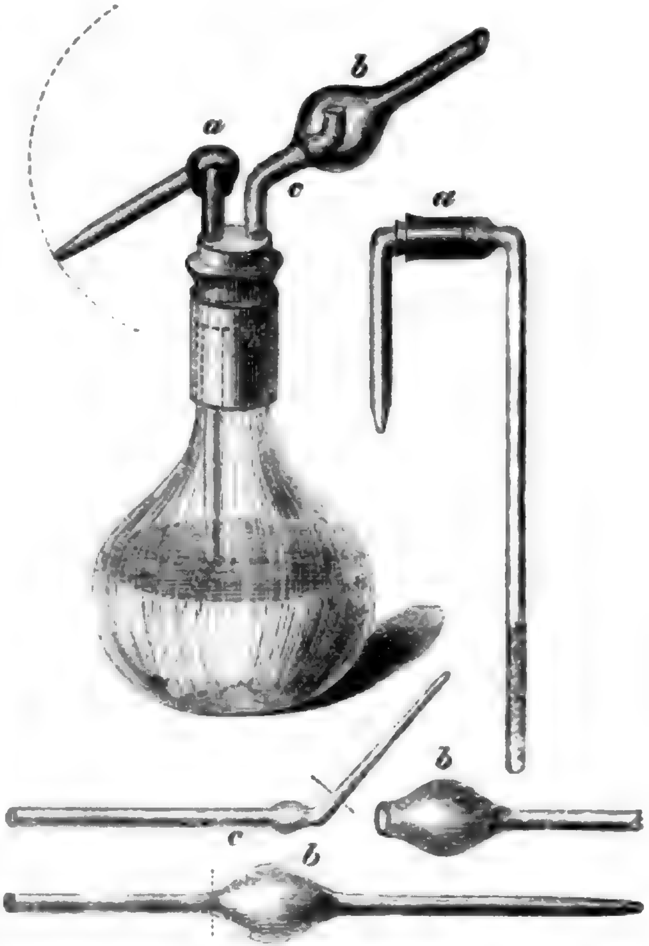


From ten to twenty minutes' action will give good bold engraving. The acid is then removed by immersing the vessels in a large vessel of water; the bordering is stripped off, and the varnish removed by rubbing with a rag steeped in a suitable solvent—in benzol, for example, when an asphaltic varnish has been used.

(3). *Wash-Bottle.*

The accompanying sketch shows a form of wash-bottle which I have had in use for over two years, and which may possibly prove as useful to others as it has been in my own work. The drawing, it is hoped, will require but little explanation. The jet-tube is bent to a right angle, and is fitted, by means of a soft perforated cork, into the socket, *a*, of the supply-tube. This allows the jet to revolve on the axis of *a*; it may be set in any position, so that a stream of the wash-water may be projected upwards or downwards, or, in short, in any required direction, an arrangement which will be found of especial convenience in washing out precipitates from beakers and similar vessels, when these are inclined with the mouth downwards over a funnel or other receiving vessel.

Fig. 6.



The mouth-piece tube is blown with a trap, which prevents contamination of the distilled water during use. This mouth-piece is made by first blowing an egg-shaped bulb, then cutting off and widening out the opening of the latter, as shown in the bottom portion of the sketch. A second piece of tube is next drawn out, a small bulb is blown in it, and the drawn out portion is bent, or rather curved, upwards, as shown in the sketch. The drawn out portion is now cut off at the position indicated by the dotted line, the cut edges are slightly rounded in the flame, and the curved tube is introduced into the larger bulb, the neck of which is now fused on to the shoulders of the smaller bulb. For the sake of durability, care should be taken that the glass is not left too thick at this joint. The ends of the tubes are now cut off to the proper length, the cut edges softened in the flame, the mouthpiece flattened, and the tube bent at the proper angle.

Melbourne, July 25, 1874.

NOTICES OF BOOKS.

The Worthies of Cumberland; John Dalton, F.R.S. By Henry Lonsdale, M.D. London: G. Routledge.

When noticing the first series of this work, we expressed some surprise that in a publication treating of the worthies of Cumberland the name of John Dalton should be omitted. We were not then aware that a second volume was in preparation. The sage of Eaglesfield, we must admit, is no easy subject for the biographer.

There are men of less merit upon whom essays, orations, and *eloges* may be produced almost without trouble and without end. Not so here. Alike in his parentage, his person, his position, and his character, Dalton offers nothing to excite the reader's imagination. His career, free alike from intense lights and deep shadows, unmarked by the eccentricity, and versatility,—shall we say the showy faults?—which often accompany genius, was singularly undramatic. He took no part in scientific or philosophic controversies. He was mixed up with no great public interests. He was neither persecuted nor petted, but for the greater part of his life simply neglected, after the orthodox English fashion. It was not his, combining the gift of expression with that of conception, to enchant his hearers with the eloquent exposition of scientific truths. He bequeathed us no aphorisms. He was not a brilliant experimentalist like Faraday or Mitscherlich. His researches, how great soever might be their ultimate value, even in a practical point of view, seemed, unlike those of Liebig, to have no direct bearing upon the arts and affairs of daily life. His discoveries could not, like those of his contemporary Davy, be exhibited as striking lecture experiments. They must be apprehended not by the senses, but by the understanding.

To select such a subject is a proof of no small courage on the part of Dr. Lonsdale. That, despite all the difficulties of the task, and despite, too, the valuable biographies by Dr. W. C. Henry and Dr. R. Angus Smith, he has produced, not an *Ilias post Homerum*, but a valuable and useful work, is a matter on which we offer him our hearty congratulations. Dr. Lonsdale tells us in his preface that he writes not so much for the scientific public as for a "quasi-popular or less instructed class of readers." Having obtained much original information, hitherto unpublished, including a number of Dalton's letters, he is enabled to present "a more correct personal history of the famous chemical philosopher than has yet appeared in print." Still the discoveries of Dalton and their bearing on the recent development and present position of science have not been overlooked, "but rather epitomised and offered, as far as circumstances permit, in a form comprehensible to all persons of average intelligence." One melancholy thought haunts us as we turn over these pages. Was it well to allow such a man to waste his time and energies in the routine duties of elementary tuition, instead of devoting them entirely to original research? How different would have been his position, and how much greater his opportunities, had he been born in Germany or Sweden?

Our author shows no lack of enthusiasm for his subject. "As pilgrimages," he says, "to the shrines of saints draw thousands to the Continent, there may be some persons in the British Islands sufficiently in love with science, not only to revere the memory of its founders, but to wish for a description of the birthplace of a great master of knowledge—John Dalton—who did more for the world's civilisation than all the reputed saints in Christendom." This may, to some, seem strong language; but the author can point in justification to the opinions of a number of the most illustrious men of the century, as quoted in his last chapter, to which the suffrages of many other and not less mighty minds might have been added.

It is known that in his sixty-eighth year Dalton was presented at court. The best thing the king, William IV, could find to say to him was:—

"Well, how are you getting on at Manchester; all quiet I suppose?"

Annual Report of the Board of Regents of the Smithsonian Institution for the year 1872. Washington: Government Printing Office.

The constitution and objects of the Smithsonian Institution are doubtless well known to our readers. Like most scientific foundations, it has been compelled to attempt too much, public opinion and official influence diverting its attention from the *increase* almost exclusively to the *diffusion* of knowledge. It is now, however, freed from many of the burdens imposed upon it,—one of which would more than have absorbed its total income—and is pursuing a career of unmistakable usefulness. We cannot help asking, parenthetically, what would have been the fate of a similar endowment in England? What would have happened if, for instance, Henry Cavendish had carried out his original design of bequeathing his property to the Royal Society, to be used in the furtherance of scientific discovery?

The bulk of the volume before us consists of translations of certain papers read before leared bodies on the Continent. Most of these are highly interesting, though we do not quite understand on what principle the selection has been made made. We are particularly struck with the "Eulogy on Ampère" delivered by Arago, an admirable picture of the great French physicist both in the laboratory and in daily life. Those, however, who think of Ampère merely as a physicist, greatly misconceive him. He was also a chemist, a mathematician, a philologian, a botanist, a zoologist, a psychologist, and a poet. We find him busied with a universal language, the grammar and dictionary of which he almost completed. His memoir on probabilities has attained universal celebrity even though it may have failed to effect its moral object, *i.e.*, to convince gamblers of the utter impossibility of ultimate success. He was a profound student of the mental phenomena of the lower animals. We cannot refrain from quoting the anecdote which first opened his eyes to the fallacy of the vulgar notions concerning the intellectual and moral life of brutes:—"Being overtaken one night, not far from Montpellier, by a violent storm, I took refuge in an inn, in the first village I found on my road. The death of a lean chicken was the immediate result of this unexpected visit. The cook, placing the almost fleshless fowl upon the spit immediately tried to seize a terrier who was to turn it. The terrier absolutely refused to perform the duty assigned him; he would yield neither to blows, threats, nor caresses. So much firmness attracting my attention, I inquired if the poor beast were making his first trial? I was told that the dog had decided in his head that he and his comrade must divide the labours of roasting regularly between them. He was the last to turn the spit, and he now concludes that it is not his turn to work. The words *it is not his turn now*, seemed to me to include a world of meaning. At my request the stable boy was sent into the street to fetch the second dog. This one showed the most exemplary docility; the rotatory drum received him, and he would soon have finished the task, if, wishing to complete the experiment, I had not caused him to be removed in order to give the refractory dog a new trial. The refractory dog, *whose turn had now come*, obeyed the first signal of the cook, entered without resistance, and went to work like a squirrel in its cage." A thinker like Ampère who at once abandoned theories if he found them incapable of being harmonised with facts, saw at once the full meaning of this incident. His brilliant discovery of the mutual attraction of two wires traversed by similar electric currents is so well known that any explanation of its importance would be out of place. Less familiar is the fact that he appeared as the ally of Saint-Hilaire in his controversy with Cuvier on the unity of structure in organic beings. The latter, a much over-rated man, who in his "Animal Kingdom Arranged according to its Organisation" made the birds of prey to follow immediately after the whales, and placed the dull almost inanimate oyster higher than the social, reasoning, progressive ant, was yet, from his knowledge of details, his talent for exposition, and his untiring industry, a formidable opponent. It is interesting to find that Ampère held in a crude form the doctrine of development, now known in a more advanced phase as Darwinism, and now as then chiefly combated by ridicule. Wide as was the range of Ampère's studies, we must not confound him with the superficial amateur. He carried everywhere his characteristic profundity and originality of thought, and "touched nothing without adorning it."

The latter part of Ampère's life furnishes a striking illustration of the views put forward in Dr. Beard's recent work. He became not merely unwilling, but unable, to study, to write, or to read. He never could be prevailed upon to write out the title and table of contents for his work on the differential and integral calculus, and it appeared without them!

Following this *eloge* of Arago we find an account of the scientific labours of Édouard Lartet; a paper on the scientific education of mechanics and artisans; an essay on organic bases; a paper by Prof. Kletzinsky on the "Nitrogen Bodies of Modern Chemistry" in which the different elements are symbolised by figures very much resembling German rolls (Semmel or Brödchen). We have, indeed, been told that such was actually the origin of graphic formulæ; a learned professor at his breakfast-table, being smitten with the fancy for representing an equivalent of hydrogen by a single member of such a roll, and oxygen, nitrogen and carbon by two, three, or four cohering together. Surely Newton's apple must now fade into insignificance. Vegetable fibrin, we see, is given as a synonym for cellulose. We have always known this name to be applied to a nitrogenous albumenoid body. The annexed formula represents, further, only two of the atoms of hydrogen in cellulose as easily replaceable.

There is further a short scheme for the qualitative determination of substances by the blowpipe, by Mr. T. Egleston; an interesting lecture on the boundary-line between geology and history; papers on the principles of crystallography; on meteorology in Russia; on phenomena manifested in telegraphic lines during an Aurora Borealis; on ethnology; on ancient aboriginal trade in North America; and on stone implements. We regret that space does not allow us to give a detailed analysis of several of these assays.

CORRESPONDENCE.

ASSOCIATION OF PUBLIC ANALYSTS.

To the Editor of the Chemical News.

Sir,—I am glad to see that the Association of Public Analysts appreciates the necessity of protesting the public and the chemical profession against incompetent persons obtaining analytical appointments. But, may I ask, How is the Association to ascertain the capacity of an analyst for appointment except by some examination test? There will be exceptional cases where the reputation of the candidate is a sufficient passport; but, in other cases, what will be taken as good evidence? We know, from experience in the Chemical Society, the deplorably loose way in which recommendations are given; and even fact of having practised analytical chemistry may be ve insufficient evidence of ability. Suppose a gentleman a pointed said to the Committee of the Association—"I a a Fellow of the Chemical Society; I was for many yea Professor of Chemistry in the Medical College of ——, and Chemical Examiner to the Government of ——; the chemistry of a country containing 25 millions of British subjects was entirely vested in me; the life or death of hundreds of accused persons has depended on my chemical evidence." The statement being perfectly correct, there would apparently be the best possible evidence of capability. Yet I am sorry to say that, under the present system of Government chemical appointments, the statement would afford no proof of the candidate possessing the faintest capability. When I find two such chemical examiners working together, reported to their Government that a brandy of sp. gr. 0·907 had a true sp. gr. (afte elimination of extraneous matters) of 0·952, that they ha obtained this *true* sp. gr. by taking that "of a solution obtained by distilling 6 ozs., adding to the first 2 ozs. that came over 4 ozs. of distilled water to make up the original quantity," that in explanation they made bad worse by accusing the 1 per cent of sugar in the brandy of having *simulated* alcohol to the hydrometer test; when the account of these chemical atrocities is published as a scientific contribution to a medical journal, I think that the Association may be warned against receiving any evidence of capability but the reputation earned by published investigations, or the results of an examination by competent authority.—I am, &c.,

Edward Nicholson.

Bangalore, Sept. 21, 1874.

CRYSTALLISATION OF PHOSPHORUS.

To the Editor of the Chemical News.

Sir,—In the "Notes and Queries" column of Chemical News, vol. xxx., p. 168, Mr. George Whewell, after referring to a paper of mine, "On the Preparation of Phosphorus Crystals," and to another on the same subject by Professor Lawrence Smith, both abstracted in the September number of the *Journal of the Chemical Society*, proceeds to describe the following experiment he made two years ago:—

In a tube filled with nitrogen was sealed up a piece of phosphorus, which, by melting before the fire, was caused to spread over the sides of the tube. In this tube, after a few days small crystals were noticed, which remained colourless four or five months, and then gradually turned lemon-yellow. At the present time a great number have disappeared, the tube having a small hole in it, caused by the expansion of the gas when sealing up the tube.

Allow me to point out that there is nothing new in preparing crystals of phosphorus by heating it in some gas having no action upon it, Mitscherlich* having thus obtained them, but too small for measurement, in 1855, and Blondlot† in 1866. Mr. Whewell states that, after melting the phosphorus, he placed the tube on one side without further application of heat; but I should infer, from the rapidity with which the crystals formed in a tube in which the pressure was sufficient to burst a hole during sealing, that some of the phosphorus was present in the liquid state, probably in the form of small globules, which I have often observed remain liquid for months, in fact until reduced to microscopic points by volatilisation. The growth of crystals in tubes that have not been heated, and in which a slight rarefaction has been caused by the absorption of the oxygen of the air originally contained, is so slow, that after months, and even years, they are scarcely visible to the unaided eye.

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* *Annales de Chimie et de Physique* (3), xlvi., p. 301, from *P Akad. Berichte*, 1855, p. 409; also in *Journ. Prakt. Chemie*, lxvi

† *Comptes Rendus*, lxiii., p. 397, Aug. 27, 1866.

Crystals formed by the volatilisation of phosphorus left in the liquid state grow rapidly, but present a marked contrast to those produced by the spontaneous sublimation of solid phosphorus, either in vacuous or non-vacuous tubes; for, whilst these are remarkable for their sharpness and distinctness, the former are always crystallised in a confused manner, the edges often much rounded, and the faces full of cavities. The change of colour to lemon-yellow noticed by Mr. Whewell was probably due to the action of diffused light, which has this effect, direct sunlight giving a ruby-red tint.

Mr. Whewell does not say that the hole, which, as I understand his description, was made at the very commencement of the experiment, was in any way covered to protect the phosphorus from the action of the atmosphere; and I am rather at a loss to understand how he obtained crystals at all, at any rate "beautiful colourless crystals," under the circumstances.

I should, perhaps, mention that the paper of mine to which he refers was read at the forty-sixth meeting of German Naturalists and Physicians, at Wiesbaden, September, 1873, an abstract of the chemical proceedings at which appeared in Chemical News, vol. xxix., p. 103, and that the delay in publishing the mode of preparing large, regular, adamantine crystals of phosphorus by spontaneous sublimation in the dark, *in vacuo*, first employed, I believe, by me in August, 1870, arose from a desire to give at the same time good measurements of the crystals, the obtaining of which was a task surrounded by many difficulties. These will be appreciated when I explain that the crystals best adapted for measurement, though but little exceeding 2 m.m. in diameter, consisted of a combination of at least seven forms of the cubic system, having a total of about 218 faces; that it was impossible to touch them for the purpose of adjustment without producing distortion, and that momentary exposure to the atmosphere was sufficient to destroy the brilliancy of the surface and render the smaller planes indistinguishable. All these difficulties, however, being at length overcome, most satisfactory measurements were obtained by Professor Maskelyne.

I am at present preparing a paper which I hope shortly to lay before the Chemical Society, on the sublimation of phosphorus, sulphur, and other bodies, under varying conditions of temperature, pressure, and light.—I am, &c.,

W. Douglas Herman.

St. Helens, Lancashire,
Oct. 10, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 10, September 7, 1874.

Sixth Note on the Electric Conductibility of Woody Bodies.—Th. du Moncel.—In this paper the author examines the manner of rendering wood non-conductive—a question of some practical importance, since the only insulator free from brittleness hitherto known suitable for the construction of electric insulators is ebonite, a substance both costly and liable, in course of time, to an efflorescence of sulphur. Ivory and guaiacum wood, which are both relatively good conductors, become nearly non-conductive if stove-dried and saturated with certain oily and resinous liquids, which close up the pores of the bodies in question, and prevent moisture from penetrating within. Other kinds of wood can be modified in the same manner. Sawdust of hard wood, agglutinated with blood, and submitted to a considerable pressure, so as to mould it into a solid tenacious body, like the hardened woods of M. Latry, is a good insulator for voltaic currents. After remaining six days in a damp cellar it showed no galvanometric deviation. Samples of wood baked and soaked in paraffin, and then exposed to moisture, were sensibly conductive. Wood stove-dried, and soaked in different varnishes, proved also still capable of re-absorbing moisture, and, consequently, of becoming conductive. Compression diminishes the conductivity of wood for the time being.

Existence of Zirco-Syenite in the Canaries.—M. Stan. Meunier.—On examining the geological collection brought by M. Webb from the Canary Islands, the author found that certain specimens of rocks from Fuertaventura were identical with the zirco-syenites of Scandinavia, especially from the neighbourhood of Christiania.

On Magnetism.—F. M. Gaugain.—(Conclusion.)*—The author has previously analysed the modifications produced in a horse-shoe magnet when its two limbs are rubbed with a bar of soft iron. When an armature of soft iron is applied to the polar surfaces of a horse-shoe magnet the magnetisation becomes augmented over all its extent. This fact appears incompatible with the theory of a magnetic matter condensed in the vicinity of the poles, and may thus be explained on the hypothesis of Ampère. The action of the magnet impresses on the molecules of the armature placed near the surface of contact a movement of rotation, which approaches them more or less to magnetic polarity. These act in the same manner upon the next layer of molecules, and the action is thus gradually propagated under the influence of both poles. The armature, thus become a magnet, reacts in turn upon the horse-shoe magnet, and impresses upon its molecules a rotatory motion, which brings them into positions more nearly polar than what they previously occupied.

Nature of the Sulphuretted Compound which Mineralises the Hot Springs of the Pyrenees.—E. Filhol.—The author quotes from a work of his, published in 1853, an experiment to prove that these springs owe their properties chiefly to the proto-sulphide of sodium.

On Chlorophyll.—E. Filhol.—The author has shown that solutions of chlorophyll, if treated with small quantities of hydrochloric acid, are split up in a remarkable manner. A blackish solid matter remains on the filter, whilst a yellowish brown liquid passes through, and is coloured an intense green by an excess of hydrochloric acid. This latter liquid, if filtered, leaves on the paper a yellow matter, whilst the filtrate is a pure blue. In case of dicotyledonous plants the black matter is amorphous. In all monocotyledons examined it is crystalline. These crystals are easily soluble in boiling alcohol at 85°. Cold alcohol dissolves mere traces. Ether, benzol, chloroform, and glacial acetic acid dissolve them readily in the cold. The colours of these solutions are not identical. Those prepared with ether and benzol are yellowish brown and fluorescent. Sulphide of carbon produces a yellow solution, less fluorescent. Chloroform gives a violet, and glacial acetic acid a violet-blue, both fluorescent. All these liquids, if examined with the spectroscope, show fine bands of absorption. These bands, the position of which varies a little with the nature of the solvents, are similar to those produced by chlorophyll itself, but do not occupy the same place in the spectrum. The yellow liquid obtained on filtering a solution of chlorophyll modified by hydrochloric acid does not show the slightest fluorescence. Hydrochloric and sulphuric acids, if concentrated, slowly dissolve the crystalline matter of chlorophyll, and produces solutions of a pure green, free from fluorescence. The spectrum of these solutions is so different from those obtained with less energetic solvents that there is reason to assume a profound modification of the substance.

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* *Comptes Rendus* January 13, June 30, September 8 and 29, November 10 and December 22, 1873; and June 15 1874.

Bulletin de la Societe Chimique de Paris, tome xxii., No. 2, July 20, 1874.

Action of Bromine upon Uric Acid; Contribution to the Study of the Isoalloxanates and of Murexide. Magnier de la Source.—Bromine attacks uric acid suspended in water, resolving it into urea and alloxan. If the temperature is allowed to rise during this reaction other products appear, among which are parabanic and oxalic acids, the former of which may thus be obtained in considerable quantities. By raising alloxan to the temperature of 240°, Hardy has succeeded in modifying this body, so that on combining with bases it gives rise to a series of coloured salts, the iso-alloxanates. These have been produced in the moist way as follows:—Uric acid suspended in forty to fifty times its weight of water is treated with bromine, which is added drop by drop till the liquid begins to grow clear. It is then poured into a capsule and concentrated in the water-bath, the delivery tube of an apparatus for disengaging hydrogen gas being carried to the bottom of the capsule. This gas sweeps away with it streams of hydrobromic gas, the liquid becomes perfectly colourless, and a carmine-red deposit begins to form on the sides of the capsule. If the evaporation is stopped, and the liquid treated with baryta water an abundant precipitate of a fine violet colour is formed at the bottom of the vessel.

Mineralogical Notes.—Antony Guyard (Hugo Tamm).—1. *Colouring Matter of Crude Nitres.*—Crudes nitres are frequently coloured sulphur-yellow or violet, both supposed to be due to organic compounds. The author finds that the yellow is merely chromate of potash, and the violet nitrate of manganese. Chromate of potash occasions the yellow colouration of the mother-liquors of saltpetre works.

2. *Existence of other Chromates in Nature.*—The masses of stoney matter which accompany raw nitres are often spotted with yellow. These yellow spots, earthy and never crystalline, are formed of mixtures of chromate of lime and chromate of magnesia in variable proportions. Thus the chromates of potash, of lime, and of magnesia may be added to the family of chrome minerals. The author has, however, never found chromate of potash except mixed with nitre.

3. *Existence of Periodate of Soda in Nature.*—Iodine exists in nitres as iodate of potash (not, as generally supposed, as iodate of soda or iodide of sodium). More rarely it is found as periodate of soda. When a nitre contains iodine, and its presence cannot be detected neither by the successive employment of chloride or nitrate of palladium and of sulphite of soda, nor by chlorine water and starch paste, it is because the iodine is in the state of periodate of soda. It is remarkable that when iodine is present as iodate it is almost always iodate of potash. When found as periodate it is always as periodate of soda, generally containing not a trace of potash.

4. *Sulphuricin.*—This mineral comes from Greece. It is a white porous silica, impregnated here and there with sulphur, and of a decided acid taste. Its composition is—

Sulphuric acid (free)	6·80
Sulphur	4·10
Water	6·10
Silica	80·38
Lime	1·25
Alumina	0·43
Oxide of iron	8·57
Magnesia	0·37
	100·00

5. *Curious Mineral of Unknown Origin.*—This mineral, very hard and well agglomerated, is formed of an intimate mixture of small grains of chrome iron and of arsenio-sulphide of nickel. It contains—

Chrome iron	65·0
Arsenio-sulphide of nickel ..	35·0
	100·0

Composition of the Hippomanes.—M. Yvon.—The author finds this production to consist of—

Water			76·19
Organic matter			9·21
Fatty matter..			1·64
Lime (oxalate and carbonate)			3·59
Ammoniaco-Magnesian-Phosphate.	2MgO ..	1·425	8·73
	PO_5 ..	2·530	
	NH_4O ..	0·926	
	12aq. ..	3·844	
Loss			0·36
			100·00

Reclamation of Priority as to the Existence of the Formines, and on the Etherification of Formic Acid by means of the Polyatomic Alcohols, properly so-called.—M. Lorin.—The author maintains that he anticipated Tollens and Henninger in the description of glyceric mono-formin.

Analysis of a Calculus found in the Intestines of a Sturgeon.—B. Delachanal and A. Mermet.

New Volumetric Method of Determining Silver.—J. Volhard.—The alkaline sulpho-cyanides produce in salts of silver a clotty precipitate as insoluble in water as the chloride of silver. The red solution of ferric sulpho-cyanide produces the same precipitate, and is decolourised at the same time. If sulpho-cyanide of potassium or ammonium is added to the solution of a silver salt, mixed with a ferric salt, a red colouration appears, which is immediately decolourised, and does not become permanent until all the silver is precipitated. This indication is extremely sensitive, and the amount of silver is easily deduced from the quantity of sulpho-cyanide solution consumed in producing a permanent colouration if the strength of the sulpho-cyanide is known. This method, much more sensitive than that of Mohr, who employs chromate of potash as indicator, can be used for the determination of all bodies which are completely precipitated by nitrate of silver from an acid solution. It is merely requisite to add nitrate of silver in excess, and determine the excess of silver remaining after precipitation. To prepare the standard solution of sulpho-cyanide of ammonium—a salt too hygroscopic to be weighed directly—we dissolve about 8 grms. in a litre of water. On the other hand, 10 grms. of fine silver (or 10·8 if the solution is to correspond to the atomic weight) is dissolved in nitric acid, and diluted with water to 1000 c.c. To 10 c.c. of this solution add 5 c.c. of ferric sulphate (at 50 grms. Fe_2O_3 per litre), and dilute with 150 to 200 c.c. of water. The sulpho-cyanide solution is then dropped in with a burette till a permanent red colouration appears. If, *e.g.*, 9·6 c.c. of the sulpho-cyanide have been required, 960 c.c. of this solution are then diluted to make up 1 litre, when each c.c. will correspond to 10 milligrms. of silver. To assay an alloy of silver 1 grm. is dissolved in nitric acid, the solution evaporated in the water-bath, 5 c.c. of ferric sulphate and 200 c.c. of water added, and the sulpho-cyanide run in. Every 1-10th of a c.c. used expresses 1-1000th of silver. The presence of copper within certain limits is without influence. If it amounts to 80 per cent the precise point of saturation is difficult to seize, either because the blue colour masks the red colouration, or because the cupric solution has an action upon the sulpho-cyanide. It will be necessary to ascertain if the sulpho-cyanide undergoes any change in keeping, and if the presence of certain metals renders the result doubtful. Finally, this method requires simplifying for alloys rich in copper and poor in silver. This simplification may be found, perhaps, in the following reaction:—When to a mixed solution of copper and silver ferro-cyanide of potassium is added, the brown precipitate of ferro-cyanide of copper does not appear till all the copper has been thrown down.

Detection of Dyes upon the Fibre.—M. F. Fohl.—Reserved for insertion in full.

No. 3, August 5, 1874.

So-called Colloid Matter of Tissues in course of Degeneration.—MM. Gautier, Cazeneuve, and Daremberg.—An interesting chemico-physiological paper, but not adapted for abstraction.

Etherification of Glycol.—M. Lorin.—The reciprocal action of oxalic acid and of glycol is analogous to that of glycerin. The formines are partially eliminated, and diformin is found in the formic acids produced; these formines are obtained again by the substitution of formiate of potash for acetate in the preparation of glycol.

The Isomeric Compounds C_2H_4IBr.—M. C. Friedel—Not suitable for abstraction.

New Eudiometer.—M. A. Dupré.—This paper ought to have been accompanied by a diagram.

Urometer and Azotometer.—M. A. Dupré.—A modification of Yvon's apparatus for determining urea by means of the hypobromite of soda.

Action of Sulphuric Acid upon Lead.—A. A. Mallard.—The lead employed in these experiments consisted of—

Lead	99·62
Antimony	0·14
Iron	0·03
Matters not determined	0·21
	100·00

The acid employed was of an ordinary quality, containing traces only of nitrous acid. Sulphurous acid was not present. The incompatibility of sulphurous acid, and of traces of nitrous acid dissolved in sulphuric acid, is not absolute. Both have been found simultaneously present. Acids below 61° B. were gradually concentrated by ebullition until they reached 205° C., the point at which acid of that strength boils. They then attack lead, yielding merely sulphurous acid and sulphate of lead. Acids above 61° B., and below 65·5° B., are concentrated by ebullition up to 320° C., the point at which acid of that strength boils. They then attack lead, producing sulphurous acid, sulphate of lead, and a little sulphur. Acid of 65·5° B. attacks lead at 250° C., yielding sulphurous acid, sulphate of lead, and sulphur.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, July and August, 1874.

This number does not contain any original chemical or physical matter.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 3, 1874.

This number is chiefly taken up with the speech of M. Wurtz on "The Theory of Atoms in the General Conception of the World," as delivered at the Lille meeting of the French Association for the Advancement of Science.

No. 4, September 24, 1874.

This number contains a recent speech delivered before the Academie des Sciences by M. Chevreul, and given by M. Moigno as an antidote to the celebrated Belfast speech of Dr. Tyndall.

Optico-Acoustic Phenomena.—In the *Journal of the Franklin Institute* Prof. A. Dobleur describes a very ingenious instrument for demonstrating optico-acoustic phenomena. He takes a tube of any material, 1 to 2 inches in diameter, and 14 inches long, or more. On one of the ends he applies a membrane of silk-paper, fine ribbon, or gold beater's skin. In the centre of this he fixes with gum a piece of looking-glass, not more than an eighth of an inch square, with the reflecting side turned outwards. When dry, it is turned to the sun-light, the open end of the tube is put in the mouth, holding the other end in such a manner that the ray of light reflected may fall upon a white wall or on a sheet of paper. If the operator then speaks or sings into the tube, the regular motion of the ray of light presents very pleasing and regular designs, which differ according to the intensity of the sound, but which are always uniform under the same conditions.

Production upon Wood of Photographic Proofs destined for Engraving.—M. T. C. Roche.—The block of wood is first covered with a layer of gelatin (0·39 grm. to 31 grms. of water) by means of a soft brush. When this coating is dry it is covered, in the dark, with a solution prepared of—(1) Red prussiate of potash, 7·80 grms.; water, 62·20 grms. (2) Ammonio-citrate of iron, 9·10 grms. in 62·20 grms. water. These solutions are mixed and filtered, and the mixture is kept in the dark. When the layer is dry it is exposed under a negative for ten to twelve minutes, and washed with a soft sponge, when a blue image appears. If thus prepared the coating does not shell off under the graver.

Carbonised Wood.—M. Hirschwald, on visiting a gallery in the Clausthal mines, abandoned for 300 to 350 years, found some wood which had been left there. It had absorbed the waters which flowed in the interstices of the schists, and had become of a brown colour and coriaceous texture. On exposure to the open air it quickly hardened, and was completely transformed into brown coal (lignite) with a conchoidal fracture. Its percentage of carbon was very similar to that found in the best Saxon lignites. This observation shows that the circumstances favourable to the natural carbonisation of wood are—(1) Situation among fragments of rocks among which circulate freely subterranean waters impregnated with metallic salts. (2) A constant and relatively elevated temperature, such as prevails in deep excavations. (3) Continuous pressure.

No. 5, October 1, 1874.

This number contains no original physical or chemica matter.

No. 6, October 8, 1874.

This number contains no chemical or physical matter which has not been noticed in the Chemical News.

Reimann's Farber Zeitung, No. 36, 1874.

This number contains a continuation of the instructions for dyeing with coal-tar colours, from which we extract the following:—

Gris d'Argent on Cotton.—Dissolve in boiling water, and sour slightly with sulphuric acid. Begin to dye cold, and raise slowly to a boil; rinse well. 10 to 15 grms. serve for 1 kilo. of cotton.

Artificial Indigo on Wool.—Take colour to 5 per cent of the weight of the cotton, and add an equal weight of acetic acid. Boil for two hours. If a darker shade is required, top with logwood. After dyeing, clear in very dilute sulphuric acid.

Jaune d'Or.—Dissolve in boiling water. For wool, begin cold, adding a little oxalic acid, and raise to a boil. This colour is a substitute for turmeric and fustic in modifying orchil browns. If a jaune d'or ground is topped with magenta a tolerably fast shade is obtained, closely resembling scarlet. 1 grm. of colour is sufficient for 1 kilo. of goods.

Cotton Blue without Mordant.—Dye on bleached cotton. Before dyeing pass through alkaline water (ammonia or soda), rinse, enter in the dye-beck cold, and acidified with sulphuric acid. Heat slowly to 40° R., and let cool again. 15 to 20 grms. serve for 1 kilo. of goods. This colour is also applicable to silk.

There are also receipts for a bright medium green on garments (cotton warps); for an aniline-violet and a Nicholson blue on the same material; for a fast and an inferior mode grey on woollen yarns; instructions for dyeing a macarat and a brown on pecking-cloth; a fast sanders-wood red on linen; catechu browns for calico-printing; and a black for felt hats.

MISCELLANEOUS.

Metropolis Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Metropolitan Board of Works and the Corporation of London on the quality of the gas supplied to the Metropolis by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the quarter which ended in September last. He reports that the average illuminating power of the Chartered Company's common gas has been as follows at the several testing-places, namely:—18·0 standard sperm candles at Beckton; 17·05 candles at Friendly Place, Mile End; and 16·89 at Ladbroke Grove. That of the Imperial Company has been equal to 16·89 candles at Carlyle Square, Chelsea; 16·07 candles at Camden Street, Camden Town; and 17·93 at Graham Road, Dalston. And that of the South Metropolitan Company has been equal to 15·58 candles at Hill Street, Peckham. The Cannel gas of the Chartered Company, at Millbank, Westminster, has been equal to 21·28 standard sperm candles. The gas, therefore, of all the companies has been constantly above the requirements of the several Acts of Parliament of 1868 and 1869. As regards purity, Dr. Letheby reports that the gas has been at all times free from sulphuretted hydrogen, and that the average amounts of sulphur in other form than this was as follows:—11·41 grains per 100 cubic feet of the gas at Beckton; 8·68 grains at Friendly Place; 17·95 grains at Ladbroke Grove; 17·02 at Millbank; 19·26 at Carlyle Square; 13·04 at Camden Street; 14·84 at Graham Road; and 12·94 at Hill Street, Peckham. On three occasions there was an excess of sulphur in the gas, namely—on the 30th of July last, when the gas of the Chartered Company, at Ladbroke Grove, contained 26·4 grains per 100 cubic feet; and on the 23rd and 26th of September, when the gas of the Imperial Company, at Bruce Terrace, Bow, contained a fraction of a grain over 20 grains per 100 feet. The slight excess in the last case was due to accidental cause from the beginning of operations at the new works. The proportions of ammonia in the gas were always below the fixed maximum of 2·5 grains per 100 cubic feet—in the Chartered gas it ranged from 0·02 to 1·46 grains per 100 feet; in the Imperial from 0·0 to 0·37 of a grain; and in the South Metropolitan it averaged 0·42 of a grain. The average results, therefore, of the testings of the gas of the several companies were fully equal to the requirements of the Acts of Parliament.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the separation and utilisation of certain mixed chemical products. C. Lowe, manufacturing chemist, Reddish, Lancaster. February 3, 1874.—No. 425. To carry out the object of this invention I take the dilute acid liquors containing sulphuric acid and picric acid obtained in the manufacture of picric acid as a lye product, and concentrate the said dilute acid liquors by rectification in any suitable vessel or vessels.

Improvements in and connected with the manufacture of sulphates of soda and potassa, and in apparatus or appliances employed therein. James Hargreaves, chemist, and Thomas Robinson, iron founder, Widnes, Lancaster. February 4, 1874.—No. 448. This consists of certain novel combinations and arrangements of parts, whereby the manufacture of sulphates by the patentees' well-known direct-action process is facilitated and cheapened. First. One of the uptake connecting pipes opens into a high-level flue. Second. A steam pump is used to draw the gases through the converting chambers. The capacities of the steam and pump cylinders are such that about one volume of steam is used for every ten volumes of gas exhausted. The exhaust steam is superheated and mixed with the sulphuric acid. Third. Slide grids with a projection or projections fit hinge-like into a cavity or cavities on the back support, and allow the grids to fall and the sulphates to be easily removed. Fourth. The heated gases or products of combustion are caused to pass by a syphon from between the cylinder top and covering plate into the converting chamber, being filled thence down through an opening in the bottom plate of one of the drawing doors to a chimney. In this way the chloride in or being filled into a chamber is prevented from being damped by condensation, and is heated by direct contact with heated gases. Fifth. The outsides of the side grids are made without perforations for from 6 to 10 inches, so as to assist in forcing a stronger current of gas through the centre of the mass in a chamber. Sixth. For condensing the hydrochloric acid evolved, an oblong tower connected to a set of tubular syphons is used. These syphons are connected with a second oblong tower, upon which is erected a wash-tower to condense the last traces. The tower is built of specially formed acid-resisting bricks or stones. Such bricks or stones form tubes, being rammed with a mixture of tar and clay, or other suitable material impermeable to acid. Seventh. The converting chambers are each speedily filled from a hopper fitted with a sliding or removable shutter. Eighth. The syphons connecting the flues and chambers are made in two pieces. The joints are made good by two plates, one with an aperture therein to allow the gas to pass when desired, and the other, without an aperture, to close the passage. Ninth. An aperture is formed on the end of each of the syphons, which enter the converting chambers, and air admitted therethrough to cool the chambers should they be allowed to become too hot. The said aperture is provided with two covers, so that by turning one, the area of inlet may be varied at pleasure. Tenth. The chambers are built in two rows at a suitable distance apart, so as to allow drawing of sulphates from the chambers at both sides. The gases after passing through one of the rows of chambers are taken through a connecting pipe to the other row, and, if necessary, back by a second pipe to the first row. Eleventh. To utilise waste heat from the sulphate apparatus, and provide means for drying the chloride into hard lumps, we place iron plates with flue spaces beneath them on the top of the arch between the two rows of chambers described under the tenth head.

Improvements in the manufacture of the several oleates of potash, soda, and ammonia, commonly known under the name of soluble oil, and applicable in the process of finishing printed calicoes and silk goods, and other cotton and silk dyed goods, and velvets. Charles Watterson, manager to James Marshall Beckett, manufacturing chemist, Vickers Street, Miles Platting, Manchester. February 4, 1874.—No. 456. The invention consists in the treatment of olein or oleic acids, distilled or obtained by pressing, from all or any sources, especially from cocoa-nut oil, palm oil, cotton-seed oil, castor oil, and olive oil and nut oils, with caustic soda, potash, or ammonia, in the following manner, viz:—I place about a ton of castor oil, olein, or oleic acid into a pan capable of holding three tons, to which I add about 8 cwt. of caustic soda, containing 22 per cent of alkali, and 200 gallons of water. I boil the mixture slowly twelve hours, after which I add about a ton of cocoa-nut oil olein, then 5 cwts. or thereabouts of caustic soda, and boil the mixture thus obtained for ten hours; I then add 3 gallons of strong ammonia or caustic potash at 60° (Twaddle's hydrometer). I then make the total bulk with water up to 3 tons, adding potash, or soda, or ammonia, for the purpose of suiting the mixture to the purpose for which it is required. This composition gives a brighter colour and softer feel to the cloth than is obtainable from the ordinary oils, tallows, and soaps now in use.

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PRIVATE INSTRUCTION in GEOLOGY and MINERALOGY can be had by Professor Tennant at his residence, 149, Strand, W.C. by those unable to attend public Lectures.

THE CHEMICAL NEWS.

Vol. XXX. No. 779.

ON THE
TRUE RELATION BETWEEN THE WEIGHTS, VOLUMES, AND SPECIFIC GRAVITIES OF THE COMPONENT ELEMENTS, AND THOSE OF THE COMPOUND, IN CHEMICAL COMBINATIONS.

By Sir F. C. KNOWLES, Bart., M.A., F.R.S.

Having been recently engaged in an enquiry which required the determination of—(1) The ratio of the sum of the volumes of oxygen gas and of vapour of carbon (together forming carbonic oxide) to the volume of carbonic oxide; (2) the ratio of the sum of the volumes of carbonic acid and of vapour of carbon, producing together carbonic oxide, to the volume of carbonic oxide so produced; (3) the ratio of the sum of the volumes of carbonic oxide and oxygen gas due to its perfect combustion, to the volume of carbonic acid so produced—all under the same conditions of temperature and pressure—I sought for information on the subject both in works of reference and from reputed chemists. I was much surprised to find that the answers to my enquiries were all of them at variance with known chemical data and relations, and that they led in some cases to conclusions palpably absurd. Upon going into the matter more deeply and exactly, I found that either I had taken the term "atomic volume" in a wrong sense, or that a fallacious conclusion had crept in and had obtained credit among chemists to the effect "that the *numerical* relation between the atomic *weights* and that between the atomic *volumes* are identical." Upon further reflection, I came to the conclusion that the exposition of this fallacy, if, as I think, such a fallacy exists, has a bearing far more important than upon the special subject which led me to perceive it. At present all the laws of chemistry with which we are acquainted, though based on the strictest induction, are more or less empirical. We know nothing of the mode of collocation of two or more primary atoms which produce a secondary atom or molecule; we know the combining weights of the substances, and in many cases also their specific gravities; that is all. It has struck me very forcibly that our path to the knowledge of the collocation must lie through the relation, if discoverable, between the specific gravities of the component atoms and that of the compound molecule, and is to be sought there in the first instance. This relation will certainly be obscured by any false conception which may prevail as to the relation of the volumes of the component elements to that of the compound body. If, after a comprehensive survey of the whole field of chemical combinations, we could by some happy hypothesis so succeed in grouping the phenomena as to be able to determine *à priori* the specific gravity of a molecule from the specific gravities of its constituent atoms, we should so far have succeeded also in converting chemistry into a deductive science.

The fallacy to which I have referred may be thus stated in an algebraical form:—

"Let $A+B=C$, then will also $\frac{A}{a}+\frac{B}{b}=\frac{C}{c}$."

In the supposed case, A, B, C would represent atomic weights, a, b, c the respective specific gravities of the components and of the compound. Now, it is true that these two conditions may co-exist, but only on condition of a certain relation existing between A, B, C and a, b, c, which is readily determinable. This is expressed by the equation deducible from the former two—

$$\frac{A}{B}=\frac{1-\frac{c}{b}}{\frac{c}{a}-1}.$$

As negative values are to be excluded, we must have either—

$$1>\frac{c}{b} \text{ and } 1<\frac{c}{a},$$

or—

$$1<\frac{c}{b} \text{ and } 1>\frac{c}{a}.$$

Now, it is scarcely necessary to say that such conditions can rarely, if ever, obtain, and are in no case known to obtain. Let us take an application of this test.

It was stated to me that, "when a given weight, C, of carbon unites with a given weight of oxygen, O, to form $C+O=CO$, the *volume* of CO is double of the *volume* of O." The density of air being 1, that of O is 1·6, that of CO being 0·9706. (The specific gravities referred to water will, of course, be all the same multiples of these.) The volumes must be equal to the weights divided by their respective specific gravities or densities. Let x be the density of the vapour of carbon; then, if the above statement be correct, we must have—

$$\frac{C}{x}+\frac{O}{1{\cdot}6}=2\times\frac{O}{1{\cdot}6}.$$

This gives—

$$\frac{C}{x}=\frac{O}{1{\cdot}6} \text{ and } x=1{\cdot}6\times\frac{C}{O}=1{\cdot}6\times\frac{6}{8}=1{\cdot}2.$$

But we must have also—

$$\frac{2O}{1{\cdot}6}=\frac{C+O}{0{\cdot}9706};$$

from this we readily deduce—

$$\frac{C}{O}=0{\cdot}21325,$$

which is in direct contradiction to the known ratio of—

$$\frac{C}{O}=\frac{6}{8}=0{\cdot}75000.$$

The assigned ratio of the volumes is, therefore, erroneous.

Now, the real question is this. "The density of O being 1·6, and that of C being x, how are we so to *pack* the weights C and O in space as to give a weight $C+O=CO$ with a density of only 0·9706?"

It cannot signify, so far as the solution of this problem is concerned, whether or not there be an attraction between the atoms of C and those of O, as it depends only on the diffusion in space of the aggregate weight of C and O, and we may for this purpose, when the atoms have taken up their new position, conceive the volumes to be simply added together, each comprising its own atoms, but so that the whole volume compared with the whole weight may give the required density, 0·9706.

This is stated in the equation—

$$\frac{C}{x}+\frac{O}{1{\cdot}6}=\frac{C+O}{0{\cdot}9706};$$

and on solving the equation we find 0·636 for the density of the vapour of carbon, that of air being 1. It will be interesting to determine experimentally the ratio of the new volume to that of O; our solution makes it as 1 : 2·8848.

Again, the statement was that "1 *volume* of carbonic acid added to 1 *volume* of carbon vapour formed 2 *volumes*[*]

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[*] We may test this proposition by assuming it to be true, and leaving for determination accordingly the value of x, the density of the vapour of carbon. This gives—

$$\frac{C}{x}+\frac{C+2O}{1{\cdot}529}:\frac{2(C+O)}{0{\cdot}9706}::1:2.$$

This, being reduced to an equation and solved as to x, we obtain $x=165$.

of carbonic oxide," this being the actual relation of the equivalents; but, adopting the above value for the density of C, 1·529 being that of CO_2, we have the ratio of the volumes—

$$\frac{C}{0·636}+\frac{C+2O}{1·529}:\frac{2(C+O)}{0·9706}=\frac{6}{0·636}+\frac{6+16}{1·529}:\frac{2(6+8)}{0·9706},$$

which gives a ratio of about 100 to 120, being an expansion of only one-fifth. We see plainly here that the numerical relation of the *equivalents* has been extended to the *volumes*, as if, in the equation $(C+2O)+C=2(C+O)$, it did not signify whether CO and $\overline{C+O}$ represented weights or volumes.

Lastly, in forming $CO_2=C+2O$ by the combustion of $\overline{C+O}$ with O, the volume was said to undergo no change. This was obviously a mistranslation of "one atom of CO added to one atom of O forms one atom of CO_2," into "one *volume* of CO added to one *volume* of O forms one *volume* of CO_2." But the correct statement, in numbers according to the real data of the case, is the ratio ($C=6$, $O=8$)—

$$\frac{C+O}{0·9706}+\frac{O}{1·6}:\frac{C+2O}{1·529}::\frac{14}{0·9706}+\frac{8}{1·6}:\frac{22}{1·529},$$

which gives, to *two* decimal places, the ratio of 135 : 100, showing a contraction of somewhat more than *one-fourth*. This determination involves no hypothesis as to the distribution in space of the constituent atoms, and is a mere translation of the facts into a numerical form. (The volumes are supposed to be referred to a common temperature and pressure.) I subjoin an abstract of desiderata.

Note.—The property of sulphuric acid in virtue of which, upon dilution with water, a great contraction of the sum of the original volumes of acid and of water takes place after mixture, with the evolution of considerable heat, might be enlisted in some useful experiments upon the varying specific gravities due to different successive collocations of the molecules, and upon the corresponding heat evolved.

Desiderata for Experiment.

(1). A physical volume of pure oxygen of 100 cubic inches at the mean pressure and temperature, and therefore of known weight, is saturated with carbon in a closed vessel by means of the voltaic current, carbonic oxide (CO) being formed. This product is allowed to cool down to the initial temperature of the oxygen. Required the volume in cubic inches of the resulting carbonic oxide?

(2). A given physical volume of carbonic acid gas, say, 100 cubic inches, in a closed vessel, is placed over carbon ignited by the electric current until it is converted into carbonic oxide. This carbonic oxide having cooled down to the initial temperature of the carbonic acid gas, required its volume?

(3). A given physical volume of carbonic oxide gas, say, 100 cubic inches, and therefore of known weight, is mixed with a volume of oxygen of the same temperature, and having its weight $= {}^{8}/_{14}$ths of the weight of the original carbonic oxide. The electric current is passed through it until carbonic acid gas is formed. After cooling down to the original temperature of the gases, required the resulting volume of the carbonic acid formed?

Mayfield, near Ryde,
October 8, 1874.

Now, the weight of a cubic foot of air is about 1·2 ozs., which makes that of a cubic foot of vapour of carbon = 198 ozs., or 12 lbs. 6 ozs., heavier than a gallon of water, which weighs only 10 lbs.' Again 1 cubic foot of carbonic acid gas, itself consisting, *by weight*, of 6 of carbon and 16 of oxygen, weighs only 1·2 × 1·529 ozs., or 1·8348 ozs. This shows the absurdity of the proposition.

ON THE

RAPID ESTIMATION OF PHOSPHORIC ACID, MAGNESIA, AND LIME.

By M. G. VILLE.

During the last fifty years our great industries have for the most part transformed their methods of work, and have succeeded at the same time in rendering them more expeditious and economical. Chemists have admitted very little change in the processes that they received from the great French school of the commencement of this century. If we mentally pass in review the descriptions in which are tabulated the results of laboratory work, we find that they can all be reduced to seven or eight categories—weighing, dividing, pulverising, heating, calcining, dissolving, precipitating, and filtering. The idea of simplifying, and especially of expediting, these various operations, by means of appropriate apparatus, has always been with me a favourite subject.

In the present paper I will describe a means of rapidly separating a precipitate from the fluid in which it has been generated.

If I add that, by the help of apparatus, the adoption of which I have suggested to chemists, I can estimate a large number of bodies—for example, lime, magnesia, phosphoric acid, and probably potash—with the utmost accuracy, and with a rapidity that could never be attained by the old method, it seems to me that this result is quite of a character to encourage others to follow up this line of enquiry, which, although humble, is nevertheless indispensable.

I will first treat of the estimation of phosphoric acid.* This estimation has been for a long time one of the most laborious and delicate of mineral analyses when the phosphates are mixed or united with iron, and especially with aluminium.

It is true that at this time the question is more advanced. Since Mr. Warington, and above all M. Brassier, have drawn the attention of chemists to the property that citrate of ammonia possesses in the highest degree of dissolving oxides of iron and aluminium, we can isolate phosphoric acid in the state of ammonio-magnesian phosphate. For this it is sufficient to add to the liquid resulting from the attack of a phosphate by weak hydrochloric acid, first some citric acid, then ammonia in excess, and lastly chloride of magnesium. In order to be correct, however, it is necessary to observe that this method has only commenced to be generally used in laboratories since M. Boussingault has shown that the presence of lime did not alter the accuracy of the results. This very accurate process is inconveniently long; the filtration is slow.

On the other hand, M. Leconte has proposed to estimate phosphoric acid by the volumetric method by means of salt of uranium. The accuracy of this process leaves nothing to be desired, but it cannot be employed in the presence of iron or aluminium.

Last year I had to perform a great number of analyses of phosphates. I tried to unite these two methods, and take from each its advantages—from that of Mr. Warington and M. Brassier, the accurate separation of aluminium and iron; from that of M. Leconte, delicacy and certainty of estimation, and the suppression of weighings. My new apparatus for rapid filtration has added to these advantages that of quickness.

I attack in the cold 2 grms. of phosphate with 50 c.c. of hydrochloric acid or weak nitric acid, and filter it. I take 5 c.c. of this solution, add at first some citric acid, then ammonia in excess, and lastly precipitate by a solution of chloride of magnesium, the liquid being maintained ammoniacal.

The phosphoric acid deposits in the form of ammonio-magnesian phosphate. By means of the exhausting filter I separate it from the supernatant liquid, wash it with ammoniacal water, exhaust again, and finally dissolve the precipitate, by means of some drops of nitric acid, and estimate volumetrically by means of acetate of uranium according to M. Leconte's process, to which I have made several useful additions.

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* I for the first time described this method, apparatus, and reactions in a patent invention of August 29th, 1871, under the number 4300, in order to take date. The description I now give is extracted, word for word, from my patent.

Thanks to my new apparatus, the union of the two methods is complete, and the quickness of the process is such that, in less than two hours, ten estimations at the least can be made.* The estimation of phosphoric acid becomes as easy as that of nitrogen by soda-lime, whilst it is more general and not less accurate.

Suppose we have to analyse superphosphates of lime of commerce. The necessity of distinguishing phosphoric acid which is in the soluble state from that which is in the insoluble state requires two parallel attacks, one with distilled water, and the other with weak nitric acid. The operation is always the same. We work on each liquid separately, as I have just pointed out in the case of natural phosphates.

I will now describe the apparatus that has so much expedited the work. A glance at the drawing is sufficient to understand their arrangement and mode of action (Fig. 1).

Fig. 1.

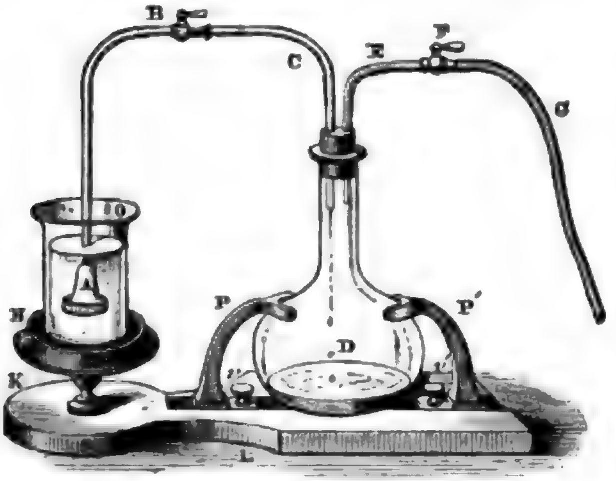
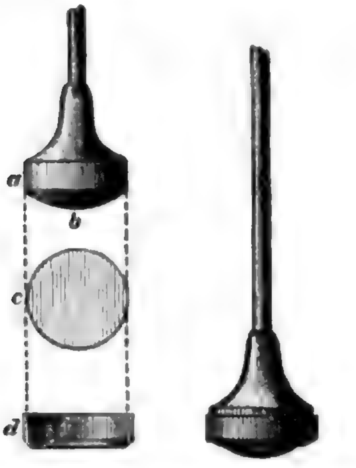


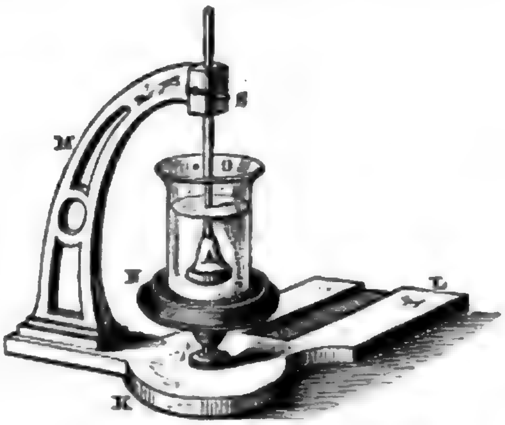
Fig. 1 A.



An exhaustion is formed equal to some centimetres of mercury in the globe, D, by the help of a small hand-pump. The base of the cone, A, covered with one or two discs of blotting-paper, held in place by a ring fitting tightly by friction, works as a true filter, which acts under pressure. M. Peligot formerly made use of a similar arrangement to separate the tribasic saccharate of lime from its mother-liquor; and M. Berjot has had recourse, more recently, to a vacuum for rapidly estimating the oil in seeds by means of sulphide of carbon.

I have adopted two forms of apparatus, one of platinum and the other glass (Fig. 2). The fragility of the latter is obviated by means of the consolidation arm, M, which firmly fixes the exhausting tube.

Fig. 2.



The facility which this method gives of multiplying estimations has led me to define, experimentally, all the conditions which could affect the precipitation of the ammonio-magnesian phosphate. Among other results, I have discovered a means of rendering the precipitation almost instantaneous. To effect this, it is necessary to operate on a moderate quantity of phosphate, and to employ an excess of chloride of magnesium. With a small quantity of chloride the precipitation is slow, with more it is quicker, with an excess it is immediate. After waiting a quarter of an hour, we may proceed with the estimation of phosphoric acid, only the filtration takes a little longer; after an hour the result is perfect.

As M. Boussingault has remarked, an excess of citrate of ammonia holds in solution very appreciable quantities of ammonio-magnesian phosphate; the loss, however, which results from it is very slight. For 0·050 grm. of phosphoric acid, and after waiting eighteen hours, not less than 6·852 grms. of citric acid were required to retain in the solution 0·002 grm. of the phosphoric acid. When the quantity of citric acid employed is from 80 to 100 times that of the phosphoric acid, there is no loss. One can judge by these examples, in which the proportion of magnesia is fixed at 0·060 grm.:—

	PO_5 Recovered in Presence of				
	Grm.	Grm.	Grm.	Grm.	Grm.
Citric acid ..	1·7130	2·5600	3·4260	5·1390	6·8520
No. 1	0·0502	0·0500	0·0502	0·0492	0·0484
No. 2	0·0500	0·0500	0·0598	0·0492	0·0482
Average	0·0501	0·0500	0·0500	0·0492	0·0483

PO_5 employed, 0·050.

On the contrary, the presence of lime completely changed the amplitude of the results.

Citrate of lime dissolves nearly three times more ammonio-magnesian phosphate than citrate of ammonia. The intervention of 0·059 grm. of lime has sufficed, in fact, to raise the loss of phosphoric acid from 0·002 grm. to 0·006 grm.; but I have ascertained that an excess of chloride of magnesium, so efficacious in hastening the precipitation of the ammonio-magnesian phosphate, completely neutralises the solvent action of the citrates of lime and ammonia, and confers on the results both accuracy and concordance.

Having arrived at this point, I have studied the precipitation of phosphoric acid in the presence of lime and aluminium, separately at first, then associated with lime; and I have arrived at this conclusion, that by keeping the quantities of citric acid, of chloride of magnesium, and of ammonia, and of the total volume of the liquid, between certain limits which I point out, the process is of irreproachable accuracy.

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* In a recent work, M. Joulie, placing in another point of view the difficulty of obtaining exact results by the gravimetric method, has proposed the previous precipitation of phosphoric acid in the state of ammonio-magnesian phosphate, which he afterwards estimates volumetrically.

This may be judged of by a few examples, in which the modifying causes have been pushed to extremity. For instance, to 0·050 grm. of phosphoric acid I have added—Lime, 0·112 grm.; aluminium, 0·088 grm.; peroxide of iron, 0·120 grm.; total, six times the weight of phosphoric acid.

PO_5 Recovered.

	After waiting eighteen hours. Grm.	After half an hour. Grm.	After quarter of an hour. Grm.
No. 1	0·0502	0·0500	0·0496
No. 2	0·0498	0·0500	0·0500
Average	0·0500	0·0500	0·0498

PO_5 employed, 0·050 grm.

Therefore, whether we are working with natural phosphates or with commercial superphosphates; whether the product contains sulphuric acid, or is free from it; whether the proportion of alumina, oxide of iron, and lime is great or small; the indications of the process are always exact and concordant.

The method possesses the two characteristics of accuracy and swiftness, and a degree of generality which render it applicable in every case which may interest physiology, industry, and agriculture.

But, if this combination of merits brings it into favour amongst chemists, it must not be forgotten that to acquire them has demanded the united efforts of Messrs. Warington, Brassier, Leconte, and Boussingault.

NOTES UPON ANIMAL CHARCOAL. THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

By ROBERT FRAZER SMITH, F.C.S.

(Continued from p. 171.)

Expt. 4.—14 grms. of anhydrous calcic sulphate, 6 grms. of reduced iron, and 3 of lampblack were intimately mixed together, and exposed to a full red heat in a crucible for an hour. After cooling, the mass was pulverised in a mortar, and afterwards boiled in a flask with strong acetic acid. The amount of H_2S evolved was very trifling; the residue, however, was completely decomposed by HCl. The reaction was not studied further, the object aimed at being to prove that iron is quite capable of appropriating the sulphur to itself in presence of an equivalent amount of calcium and a sufficiently elevated temperature.

Expt. 5.—Equivalent weights of calcium carbonate and ferrous sulphide were heated to the temperature requisite for revivifying ordinary char, but no portion of the sulphur was transferred to the calcium.

The evil effects arising from the presence of sulphides in char are in many houses never felt, and to chemists employed in such the subject may possess little interest. On the other hand, many English and foreign refineries have suffered much, especially since the unsparing use of sulphur dioxide has again become fashionable. The amount of sulphate in char, though it may exceed 1 per cent, can do no harm unless the temperature has been excessive in the kiln.

If the temperature has been too high, calcium monosulphide is produced in the first instance. This substance can do no *permanent* injury, unless iron is present to fix and perpetuate the sulphur. The sugar liquor dissolves the calcium sulphide, acquiring the well-known disagreeable tinges probably due to some substance akin to the colouring matters of Croissant and Bretonnière. The effect at the time is sufficiently distressing and disastrous, but the charcoal is not anything the worse if proper care be at once exercised. If, however, iron be present in quite sufficient quantity to take up all the reduced sulphur, and if this over-heating should occur more than once or twice, then a "disease" has been introduced which is almost beyond cure. Fermentation, either natural or artificial, must be resorted to, and this is a remedy which is often not much better than the trouble itself. The acids produced or used attack and destroy, in spite of varnishing, the iron cisterns and tanks, and by introducing fresh quantities of iron into the char, while at the moment removing the sulphides, simply spread a net for the gathering of a fresh supply.

I felt interested to know whether ferrous sulphide would be decomposed by lactic acid, the representative acid of sour sugar liquors.

Expt. 6.—Syrupy lactic acid and anhydrous ferrous sulphide were heated together. The latter was completely decomposed with the usual evolution of gas.

Expt. 7.—Sour "sweet water" was poured upon finely-divided ferrous sulphide in a flask. This was corked with a piece of "lead-paper" inserted in the neck. After a few hours, the paper was tinged, and the brown liquor, after filtration, when boiled, and the gas passed through lead acetate, yielded a grey-coloured precipitate.

Expt. 8.—A portion of the product from Expt. 1 was boiled with sour raw liquor. The greater portion of the sulphur was evolved as H_2S. The expulsion of ferrous sulphide by the organic acids of sugar liquors is slow and difficult, as compared with the calcium compound.

Expt. 9.—A sample of char received from an English refinery, and containing—

Calcic sulphate = 0·619 per cent.
Ferrous sulphide = 0·407 „

was placed in a tube, and raw sugar-liquor of 23° B., containing 1 per cent of lactic acid was slowly passed through; the char being finally thoroughly washed with distilled water at 170° F., dried, and burned in the usual way. After this treatment, the—

Calcic sulphate was found = 0·601 per cent.
Ferrous sulphide „ = 0·350 „

With decidedly acid sweet waters the sulphides are partly decomposed, though not to the extent often imagined. When no acidity is allowed to develop, the sulphides are sure to accumulate, especially when the chemist in charge is too lazy, as has happened now and then, to work out the causes of such accumulation and to point out the only cure. Of course, in Greenock such a state of affairs could not possibly exist, as our refiners look well to their own interests, and employ chemists in their laboratories who are "diligent in business."

The method used for estimating acidity in raw dark-coloured sugar-liquors by means of standard acid and litmus-paper is quite unreliable, as the alkaline salts of organic acids are alkaline to test-paper. A better way is to weigh out 5 grms. of powdered freshly-heated marble, and boil gently for a few minutes in a flask with an inverted condenser until gas ceases to come off. Wash the marble by decantation, dry, ignite gently, and weigh. 40 parts of calcium = 89 of lactic acid.

Expt. 10.—Sample of char, containing—

Sulphates = 0·659 per cent,
Ferrous sulphide = 0·360 „

was boiled with water for four hours, collected, and washed with boiling-water. Dried perfectly, showed—

Sulphates = 0·503 per cent.
Ferrous sulphide = 0·377 „

The sulphide is unaltered, but the sulphates are perceptibly diminished.

Expt. 11.—Another sample of the same was washed with boiling-water until the washings ceased to react with baric sulphate, dried, and—

Sulphates = 0·630 per cent.
Ferrous sulphide = 0·382 „

Expt. 12.—The char from last experiment was treated with its proper proportion of neutral raw liquor, then washed with hot water.

Sulphates = 0·568 per cent.
Ferrous sulphide = 0·407 „

The method still frequently used, of estimating the sulphur in char by means of fuming nitric acid, is neither so accurate or so elegant as the potassium nitrate process. 5 grms. of finely-powdered char are mixed well with 5 to 10 grms. of a mixture of equal parts of absolutely sulphur-free potassium nitrate and carbonate. After heating in the muffle for half-an-hour, the semi-fused mass is washed into a beaker with boiling-water, HCl added in slight excess, and the solution vigorously boiled for some time. It is then filtered and treated with baric chloride in the usual way.

A minute amount of sulphur exists along with the carbon in organic combination; in an old char, one estimation gave 0·02 per cent.

As the iron is so closely connected with the sulphur, a very old char was taken, and divided into various sizes, to ascertain whether in this case, also, the iron was uniformly distributed through the bulk.

12 to 16	0·92	per cent ferric oxide.
16 „ 24	0·99	„ „
24 „ 30	0·91	„ „
30 „ 40	0·98	„ „
40 „ 50	1·06	„ „
50 „ 60	1·09	„ „
Impalpable dust	1·32	„ „

The average amount of iron in twenty-five samples of working stocks from all parts of the kingdom was 0·75 Fe_2O_3.

(To be continued).

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph.D.,

(Continued from page 182.)

Anthracen having become of such great commercial importance, its most exhaustive scientific examination became a matter of course; and the last few years have brought us, especially from Germany, a number of most valuable investigations on nearly all the solid hydro-carbons. Berthelot had previously separated and described many of them, but perhaps he had not sufficiently large or sufficiently pure quantities to work upon; at all events more recent publications, the results chiefly of Graebe's and Liebermann's researches, have somewhat modified several of Berthelot's conclusions. In the following table I have given a list of these solid hydrocarbons, their formulæ, melting-point, and boiling-point, as far as they are known at present:—

Solid Hydrocarbons.

Name.	Formula.	Melting Point. Deg. C.	Boiling Point. Deg. C.
Naphthalene	$C_{10}H_8$	79	220
Acenaphthene	$C_{12}H_{10}$	100	285
Fluorene	—	113	305
Phenanthren	$C_{14}H_{10}$	110	340
Anthracen	$C_{14}H_{10}$	213	360
Pyrene	$C_{16}H_{10}$	180	—
Chrysene	$C_{18}H_{12}$	248	360
Retene	$C_{18}H_{18}$	95	400
Benzerythrene	—	—	—

Variable quantities of all these compounds are found in commercial anthracen, and their complete separation becomes extremely difficult. In treating the commercial article it will always be best to remove the oil as completely as possible before attempting any further separation, and for this reason:—The oil itself is almost the best solvent of all the solid hydrocarbons, including anthracen, which is shown by the fact that after the settlement of the crystalline deposits in the oil, a considerable quantity is often re-dissolved with a slight increase in temperature of the air; if therefore, a sample, containing much oil, is treated with a solvent, the combined actions of oil and such solvent removes considerably more anthracen than the solvent alone. This remark holds good with alcohol and bisulphide of carbon analyses; a soft sample containing much oil always shows a lower percentage than the same sample previously pressed and separated from the oil.

The attempt to give a separate and distinct account of the characteristics of these solid hydrocarbons would be useless for practical purposes, because, with the exception of the first and last, they are extremely similar to one another, and a quantitative separation becomes a matter of great difficulty. The difference in the action of alcohol, ether, bisulphide of carbon, benzol, petroleum, and other solvents in merely a matter of degree. Nitric acid and sulphuric acid, chlorine, and bromine, produce similar compounds of addition or substitution. A solution of picric acid, mixed with a solution of the hydrocarbons, forms a series of compounds varying in colour from yellow and light orange, to dark blood-red, but which are so little stable that even an excess of the solvent, alcohol for instance, separates the acid again. Even similar products of oxidation are obtained from most of them, at least as far as they have been studied. Naphthalene may pretty easily be separated; all solvents take it up most freely; the low melting- and boiling-point is very marked; even water-vapour carries it off, and it may thus be purified. It is formed during the manufacture of gas, and is partly carried off and held in suspension by the gas. With a fall in temperature it often solidifies in the gas-pipes, so as almost to choke them up, and thus often becomes a great nuisance to the gas manufacturer, especially as by its abstraction from the gas the illuminating power of the last is sensibly decreased.

Benzerythrene, the last substance on our list, is very little known, and has scarcely yet been studied. It is the very last product in distilling pitch, and may thus be separated without difficulty. It is of a resinous character, After nearly all the oil with the hydrocarbons has passed over, this last product appears in the form of a bright red powdery vapour. It soon loses its fine colour on exposure to light, and assumes a dull brown colour.

Another substance has been separated from crude anthracen by Graebe and Caro, which they have named *Acridine*, $C_{12}H_9N$, and which is therefore a base containing nitrogen. This is remarkable for its intensely irritating action upon the skin and mucous membrane. The least particle of the dust inhaled produces most violent sneezing. Although it is present only in very minute quantities, it often is the cause of great annoyance to the workmen.

I now return to that point of my diagram where the tar is separated into oil and pitch. Finding that the anthracen passes over just at the last moment of the distillation, it was natural to assume that more might be left behind which could be separated on continuing or renewing the distillation. Many suggestions have been made to carry out this idea of obtaining anthracen in such a manner, but without destroying the pitch or without coking it, and they all appear to have been made without being verified by practical experiment.

Professor Kopp, whose contributions to the history of anthracen I have already mentioned, was perhaps the first to propose to melt pitch in a suitable vessel and to carry off the anthracen vapours by introducing superheated steam or air. Now it is well known what will happen in either case; the least trace of water is the great trouble in distilling tar or pitch, because it makes the whole mass froth up and run over into the condensing pipes, and this will surely happen on blowing superheated steam into the molten pitch. So also with introducing a current of air into the hot mass, which will result in another slight inconvenience—it is sure to set fire to the contents of the still and to cause an explosion. This Professor Kopp seems to have foreseen himself, because he recommends us to deprive the air of its oxygen by passing it through red-hot iron tubes filled with charcoal.

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* Read before the Society of Arts, Chemical Section.

But the object of these operations is to save the pitch which shall remain sufficiently fluid to run out of the still at the end of the operation.

The late Professor Calvert, who most successfully pursued scientific investigation and its practical application, and who I believe was the first to speak of the very subject of my paper in this room, in one of his Cantor lectures, expressed his opinion in the following words at Manchester:—

"I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coking, but the expense, difficulty, and danger of such operation are such that I doubt if they can be overcome so as to produce anthracen of comparative purity on a commercial scale."

These remarks, I think, must refer to Professor Kopp's suggestions, and in that respect they are no doubt most applicable.

The records of the Patent-Office bear witness to a good deal of activity in this direction. The first patent was taken out by Broenner and Gutzkow. The principal claim of this patent is the process of converting anthracen into alizarine, but they also claim the production of anthracen from pitch by the very process I have just described, viz., by passing steam into the still.

The next patent was taken out by Mr. Henry Fenner and myself, and we were the first to distinctly claim the production of anthracen from coal-tar pitch, either as a continuous process of the tar distillation, or a separate operation, but in all cases we continue the distillation to the complete coking of the pitch; we also were the first to practically carry out this process, and to obtain thereby anthracen on a large scale. This patent, like every other patent which is worth anything, has been made the subject of a good deal of discussion. First, it was asserted that everybody had done exactly the same thing long before; then it became quite evident the thing could not be done at all; lastly, it might possibly be done, but to no purpose.

Looking at the difference in distilling tar and pitch, it will readily be understood that the result must be somewhat different; in the first case the impurities are chiefly those hydrocarbons which pass over before the anthracen, and which have a lower melting-point, while in the second case the higher hydrocarbons form the principal impurities. At first a great dislike, not to say prejudice, was created against the anthracen made from pitch, and with apparent reason, very likely because the buyers did not recognise the difference in the impurities, which of course necessitated a different treatment in the purification, and consequently the consumers did not succeed to their satisfaction in converting it into anthrachinon. However, all these difficulties have gradually been overcome; it has been satisfactorily demonstrated that this kind of anthracen, properly purified, is identical with that obtained from tar, that it can just as easily be converted into anthrachinon and alizarine, of both of which I have samples on the table, and the highly purified products of the Anthracen Company (Limited), who works our patent, is beginning to find universal favour with the intelligent alizarine makers.

The separation of anthracen from pitch is most important, because the yield is thereby greatly increased; tar alone gives about a half per cent of pure anthracen, while tar and pitch give at least two per cent.

The crude anthracen obtained from pitch is treated somewhat similarly to the tar-anthracen. The oil is allowed to stand for some time, it is then filtered, pressed, hydraulic pressed, and treated with suitable solvents to remove most of the impurities, and there is no difficulty whatever in thus obtaining an article containing 70 per cent and more of pure anthracen.

The residue in the retort is a valuable coke, which is free from sulphur and phosphorus, and nearly free from mineral substances, containing about 99 per cent of carbon, and having an intense heating power; I need scarcely say it is vastly superior to the ordinary gas coke, which contains all the mineral impurities of the coal in a concentrated form. There are several other patents in reference to the manufacture and purification of anthracen —Clark, Lucas, Caspers, and others—which I need not further notice.

None of the natural pitch or bitumen deposits seems to yield anthracen. I have myself tried Val de Travers, Trinidad, and several other of these deposits, without getting any hydrocarbon of this series. We must at present, therefore, look to the coal tar as our only starting point.

The yield of anthracen depends somewhat upon the quality of coal, and certainly also upon the degree of heat to which the coal has been exposed in the gas manufacture. Thus it is generally assumed that Scotch coals yield little anthracen, while South Staffordshire coal is rich in anthracen.

Pure anthracen crystallises in rhomboidal plates, which melt at 213° C. to a clear colourless liquid; it distils at about 360° C. Nearly pure anthracen may be obtained by melting a partially purified sample in a retort, and passing a strong current of air through it, when the anthracen is carried off, and may be collected in the shape of brilliant flakes, or it may also be purified by sublimation.

I have determined the solubility of pure anthracen in alcohol of different specific gravity, and also in some other solvents, and the result is as follows:—

		Per cent Anthracen at 15° C.			Per cent Anthracen at 15° C.	
		By volume.	By weight.		By volume.	By weight.
Alcohol ..	800	0·472	0·591	Ether	0·858	1·175
" ..	825	0·424	0·574	Chloroform	2·587	1·736
" ..	830	0·408	0·491	Bisulphide of Carbon	1·180	1·478
" ..	835	0·397	0·475			
" ..	840	0·387	0·460	Glacial Acetic Acid	0·472	0·444
" ..	850	0·360	0·423	Benzol	1·470	1·661
				Petroleum	0·291	0·394

(To be continued.)

CORRESPONDENCE.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

Sir,—Referring to a "Gloucestershire Farmer's" letter, in Chemical News, vol. xxx., p. 164, your correspondent through a printer's error stated that superphosphate of lime at 3s. 6d. per unit is £7 10s. per ton; it should be £17 10s. It, however, shows the absurdity of chemists appraising articles the market value of which they have no knowledge, and, from recent exposures, do not seem even able to analyse correctly.

If chemists wish to save their profession from being looked upon by the commercial world as worse than useless, they should decline to put themselves in the position of valuators, which is quite out of their province, and only makes them appear ridiculous in the sight of the commercial community.

I would also hint that analytical chemists should determine which is the best method for doing commercial analyses, and arrange that they all analyse by that method only, and not continue to pursue the absurd course they are now doing, viz., that of each analysing by his own pet process, in consequence of which the results sometimes vary as much as 10 per cent, showing, in the case of superphosphate of lime, a difference in money value of 35s. per ton, and clearly showing the absurdity of chemists doing their own work in a bungling, untrustworthy manner, and yet, in the face of all their errors, set themselves before the public as authorities on the value of products they cannot analyse correctly.

Purchasers of manures are, as a rule, well aware of the prices ruling, and competition is so keen as to prevent manufacturers attempting an overcharge. If a "Gloucestershire Farmer" does not already know, I may inform him that any manufacturer will be glad to supply him with superphosphate of lime at from 3s. 3d. to 3s. 6d. per unit.—I am, &c.,

A Reader.

October 21, 1874.

FERROUS SULPHIDE IN CHARCOAL.

To the Editor of the Chemical News.

Sir,—I notice in the Chemical News, vol. xxx., p. 171, a communication entitled "Notes upon Animal Charcoal: the Presence of Ferrous Sulphide in Char," by Robert Frazer Smith, F.C.S.

With regard to this paper, allow me to say that the presence of ferrous sulphide in char was supposed by Dr. Wallace, of Glasgow, and myself, from certain analyses made by me about two years ago. I also, at a subsequent period, examined the deposit on the kiln pipes. Dr. Wallace also examined the deposit, on his attention being drawn to it by me, and the figures given by Mr. Robert Frazer Smith are nearly identical with those found by Dr. Wallace and myself.

The investigation of this point is therefore not new, but, on the contrary, has been freely discussed by myself with several chemists in this neighbourhood. Further, the whole of my results and information on the subject were communicated by me to Mr. Robert Frazer Smith himself about eight months ago, and I leave it to the readers of your journal to judge if it is at all courteous on his part to discuss this question, and publish the statements contained in his article (which were substantially the same as those given by me to him), without in the slightest degree acknowledging my connection with the matter.—I am, &c.,

R. Speir.

Dellingburn Sugar Refinery, Greenock,
October 22, 1874.

DOUBLE IODIDES AND CHLORIDES.

To the Editor of the Chemical News.

Sir,—In the last number of the *Journal of the Chemical Society* there is an abstract of a paper by Mr. Lea, on an interesting compound of silver chloride with mercuric iodide. A quite similar compound was obtained five or six years ago in the laboratory of University College, by adding a few drops of silver nitrate to neutral Nessler's solution. It may interest your readers to learn that a corresponding *copper* compound can be obtained by using cupric sulphate in place of silver nitrate; and that the changes of colour which the compound thus formed undergoes on being heated are as remarkable as those observed with its silver analogue.—I am, &c.,

Temple Orme.

University College School, London, N.W.,
October 22, 1874.

CRYSTALLISATION OF PHOSPHORUS.

To the Editor of the Chemical News.

Sir,—In reply to Mr. Herman's letter (Chemical News, vol. xxx., p. 194), I beg to say that the hole in the tube is sufficiently large to admit the point of a needle, it being made up by a portion of the phosphorus, the oxidation of which in the meantime has caused the disappearance of some of the crystals.

The phosphorus was not under sufficient pressure to liquefy it, but, on the other hand, was under slightly reduced pressure, which caused the phosphorus to crystallise quickly.

I see no reason in my account for the following passage in his letter:—"The rapidity with which the crystals formed in a tube in which the pressure was sufficient to *burst* a hole during sealing." It sounds like an explosion.

Mr. Herman says:—"The growth of crystals in tubes that have not been *heated*, and in which a slight rarefaction has been caused by the absorption of the oxygen of the air originally contained, is so slow, that after months, and even years, they are scarcely visible to the unaided eye."

If Mr. Herman will "heat" the phosphorus, and spread it over the sides of the tube, he will find that it will not take "months or years," but only "weeks," to make "beautiful colourless crystals" from the phosphorus, which will be slightly red.

I have made a quantity of colourless crystals, since I wrote to the Chemical News, by placing in a test-tube a piece of phosphorus, "corking" it up, melting the phosphorus, and causing it to spread over the sides of the tube, placing it in a freezing mixture for about a day, then allowing it to stand about five weeks.

I sent the tubes on Monday last to a well-known mineralogist, who has promised to examine them for me.

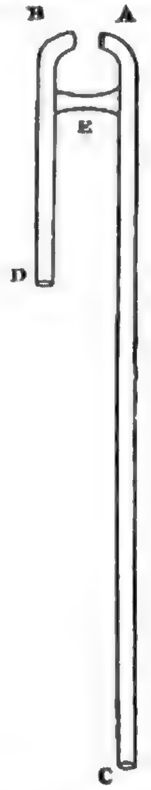
I shall be glad of Mr. Herman's opinion of the originality of the above method. Should Mr. Herman think the tube with the hole in a "myth," if he will send you his address I will send it to him.—I am, &c.,

George Whewell.

POISON SYPHON.

To the Editor of the Chemical News.

Sir,—This poison syphon consists of two pieces of glass tube, AC and BD, of about ¼-in. bore. These are held at a distance of about 1¼ inches apart by the piece E. There is no communication through E. A piece of india-rubber tube, provided with a pinchcock, connects B to A. It is filled with water, and the short end placed in the liquid we wish to decant, which will at once flow through when the pinchcock is opened, this latter also regulating



the rate of delivery. When it is desirous to remove a liquid without admixture with water, the syphon is first filled with water, and the pinchcock opened for an instant to allow about an inch of the water to flow from the long leg, a corresponding quantity of air rushing up the short one. The short leg is placed in the liquid, which is, of course, separated from the water in the syphon by the bubble of air; the pinchcock is opened till this bubble of air reaches C, when all the water has been driven out, and its place taken by the liquid. By the same means it may be rinsed out after use, and should be hung up by the loop of the pinchcock. The water will not flow from the open end of a tube of such small bore.—I am, &c.,

ROLAND H. RIDOUT.

Grammar School, Monmouth,
Oct. 20, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 11, September 14, 1874.

Prof. A. W. Hoffman announces that the discovery of his pupils, MM. Tiemann and Hartmann, who succeeded in producing vanillin from the cambium of the pine tree, has been made available in practice. The juice of a tree of average size yields vanillin of the value of about 100 francs, and the timber is not damaged by the operation.

New Conditions for the Production of the Electric Effluve, and its Influence upon Chemical Reactions. M. A. Boillot.—The author, in continuing his researches on the nature of ozone, and on the reactions produced by the electric effluve by means of the apparatus described in previous communications, has been led to operate under the following novel conditions:—Instead of forcing the gas to pass between tubes forming a very narrow annular cylindric space, traversed by the effluve, he wished to ascertain what would happen on experimenting with the same source of electricity in a much larger space. To this end he took a first tube of glass, 36 centimetres long and 1 m.m. in internal diameter, and filled it with graphite reduced to a fine powder. One of its ends was closed at the lamp, and to the other end was sealed a platinum wire communicating with the graphite. This small tube was placed in the centre of a tube of medium size, of 9 m.m. internal diameter, so that there was an interval of at least 3 m.m. between the sides of the two tubes in the entire length of the annular cylindric space which they formed. Into this space the gases were to penetrate, and there undergo the action of the effluve, being in contact merely with the sides of the tubes. The above combination of tubes was fixed in a third and larger tube of the same length as the former, the annular space being here also filled up with powdered graphite. The two rings of carbon at the ends of the large (outer) tube were then stoppered with shellac, a platinum wire being fixed in one of the rings so as to communicate with the carbon in the large tube at the opposite end to the platinum wire in the inner tube. From this latter side the gas enters into the space left between the small and the medium tube, which is prolonged at the other end, and re-curved over the trough where the gas has collected which has undergone the action of the electricity. This electricity is produced by connecting the platinum wires of the apparatus with the electrodes of an induction coil working with two, three, four, or five moderate sized Bunsen elements. In these conditions, and under the action of so feeble an electric tension, the effluve acts upon the gaseous current experimented upon. Both with atmospheric air and with oxygen ozone was produced in proportions not less than with the author's other apparatus.

Certain Tungstiferous Minerals from Meymac.—Ad. Carnot.—Three tungstiferous minerals are found at Meymac—wolfram, calcareous scheelite, and hydrous tungstic acid. Wolfram occurs in lamellar masses, brilliant, and of easy cleavage. Definite crystals have not been met with. It is less black and brilliant than the wolfram of Zinnwald (Bohemia), or that of the Puy-les-Vignes (Haute Vienne). Its powder is a light brown; it is not magnetic; its sp. gr. is 6·54. The fracture shows dull brown spots, irregularly distributed. Its composition is:—

Tungstic acid	72·67
Ferrous oxide	14·70
Manganous oxide..	3·38
Lime	0·70
Magnesia	traces
Tantalic acid..	0·90
Quartz, clay, &c...	4·00
Water	1·55
	100·00

Scheelite, or tungstate of lime, is found in masses of a crystalline texture, a vitreous—slightly adamantine—lustre, and a grey or brownish colour. Its fracture is lamellar, and occasionally iridescent. Its composition is—

Tungstic acid	74·20
Lime	18·84
Ferric oxide	1·51
Manganic oxide	0·35
Tantalic acid	0·40
Gangue (quartz)	4·24
	99·54

Hydrated tungstic acid takes in various places a yellow or greenish yellow, preserving its crystalline texture, and sensible cleavage. At other times its transformation is more complete, and the mineral is friable between the fingers of a distinctly yellow or brownish colour, and a resinous lustre. If gradually heated its colour deepens to an orange-brown, and finally it becomes almost black. It consists of—

Tungstic acid	71·85	74·25	75·12
Tantalic acid	1·00	1·05	0·70
Lime	2·50	4·65	7·00
Oxide of iron	6·00	6·10	6·25
Oxide of manganese..	0·75	0·65	0·32
Water	12·93	11·75	6·85
Gangue	4·50	1·85	2·55
	99·53	100·30	98·79

Papers on the treatment of the phylloxera have been contributed by M. Balbiani, M. Mouillefer, M. Rommier, M. Maurice Girard, M. G. Beaume, and M. Cauvy. M. Dumas commented at some length upon the first of these reports.

Causes which Modify the "Setting" of Gypsum; New Cements with Bases of Gypsum and Lime.—M. Ed. Landrin.—The author finds that plaster sets most rapidly when it contains 20 per cent of water. Slowness of setting may be produced by means of an excess of water, or more conveniently by gum, glycerin, gelatin, powder of mallows, &c. Inert bodies, such as sand, sulphate of baryta, and oxide of iron, do not answer the same end. Gypsum containing 10 per cent of lime as carbonate gives very good results.

Action of Heat upon Phenylxylen.—M. P. Barbier.—The author gives an account of the preparation and properties of phenylxylen. Like its isomer, benzyltoluen, it yields anthracen, but the secondary products are different, consisting chiefly of a mixture of benzol and xylen volatile at 140° C.

Case of Decomposition of Chloral Hydrate.—M. Tanret.—Chloral hydrate is decomposed by permanganate in an alkaline solution, yielding carbonic oxide, carbonic acid, formic acid, and an alkaline chloride.

Development of Red Vapours during the Boiling of Saccharine Juices.—E. J. Maumené.—The author has observed an extraordinary evolution of red vapours at the moment when the air-pumps of the vacuum pans began to work, and at nearly all stages of the operation. There is generally a notable amount of nitrates in the juice of the beetroot. M. Maumené finds that sugar may be the cause, or one of the causes, of the formation of these red vapours. Whenever the juices contain nitrate of ammonia their decomposition is imminent. This is certainly one of the most active causes of discolouring the boiled mass, and of molassification in the last stage of the boiling process. The ammonia may be expelled by lime. The juice mixed with lime and water is considerably ameliorated if allowed to stand for twenty-four hours.

Synthesis of Purpurin.—M. F. de Lalande.—To 8 to 10 parts of concentrated sulphuric acid are added 1 part of alizarin dried and powdered, and 1 part of dried arsenic acid, or of peroxide of manganese. The temperature is gradually raised to 150° or 160° until a drop of the mixture, if thrown into water containing a little caustic soda, gives the colouration of purpurin. The mass is then thrown into a large quantity of water; the precipitate, exhausted with cold water, is then dissolved in a sufficient volume of a cold saturated solution of alum, and deposits on the addition of an acid abundant flakes of purpurin, which may be purified by a second solution in alum-water, followed by a crystallisation from superheated water.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
No. 12, July 27, 1874.

Galvanic Conductive Power of Fused Salts.—F. Braun.—The numbers showing the conductive power of fused salts follow the same order in magnitude as those for saline solutions. Taking mercury = 100 millions, and sulphuric acid = 7700, the numbers lie between 32,000 ($PbCl_2$) and 88 ($ZnCl_2$). A connection between the galvanic conductibility and other physical properties (such as cohesion, melting-point, specific gravity, toughness), or chemical properties (such as molecular weight, molecular volume, quantivalence of the metal of the salts, or heat of decomposition) could not be recognised.

On Tertiary Nitrobutan.—J. Tschermak.—Nitrobutan, treated in the usual manner, yields neither a bromine derivative nor a nitrolic acid.

Action of Nitrous Acid upon Dimethylanilin and on Nitrosophenol.—Adolph Baeyer and H. Caro.—Nitrosophenol is converted into iso-nitrophenol by oxidation, and into amidophenol by reduction.

Synthesis of Anthrachinon Derivatives from Benzol Derivatives and Phthalic Acid.—A. Baeyer and H. Caro.—In this paper are described the mutual action of phthalic acid and phenol, oxy-anthrachinon, and erythroxy-anthrachinon. The characteristic reaction of these two bodies are tabulated in parallel columns. The authors further describe the action of phthalic acid upon pyrocatechin, upon hydrochinon, and upon other benzol derivatives.

Relations Between the Chemical Action of the Solar Spectrum, Absorption, and Anomalous Dispersion.—Hermann Vogel.—Further remarkable results have been obtained in pursuing the investigations described in *Berichte*, vi., p. 1302, and vii., 545. Here belongs the quantity of the colouring matter added to the bromide of silver. It might seem that much colour would have a great effect, but this is not the case, and sometimes the very reverse is observed. This is especially the case with naphthalin red, picrate of methyl-rosaniline, and aldehyd green. This phenomenon is parallel with the anomalous dispersion described by Kundt (*Pogg. Ann.*, 142, p. 163; 143, p. 259; and 144, p. 128). The elevation of the index of refraction corresponds to an elevation of sensibility, and its diminution to a decrease of sensibility, so that the chemical action of light appears to depend on the velocity of light in the excited media.

Peroxide of Hydrogen as a Cosmetic.—A. von Schrötter.—A description of a lotion for giving a gold colour to the hair.

Derivatives of Benzyl-Toluol, and of the Tolyl-Phenyl-Ketons.—H. Plaskuda and Th. Zincke.

α- and β-Benzoyl-Benzoic Acid.—H. Plaskuda.—These two papers are not suited for abstraction.

On Ultramarine.—E. Büchner.—The author proves experimentally that silica is absolutely essential for the formation of ultramarine. The decomposition of ultramarine by concentrated hydrochloric acid is not complete, and undecomposed particles can, in most cases, be detected with the microscope in the residue. Complete decomposition is only obtained by repeated treatment with concentrated sulphuric acid. Permanganate of potash is the best agent for oxidising the sulphur. He concludes that natural ultramarine has been formed from natrolite, acted upon by vapour of sulphur. He considers that Scheffer's red and yellow ultramarine (*Berichte*, v., 19) are products of the decomposition of ultramarine at an elevated temperature. He disputes the view of Dr. R. Hoffmann, who asserts that he has obtained crystalline ultramarine, and he shows that crystals of the very form described by Hoffmann occur both in the clay employed and in the residue from the decomposition of ultramarine by acids.

Preparation of Hypo-Phosphorous Acid.—Julius Thomsen.—285 grms. of pure hypo-phosphite of baryta were dissolved in 5 litres of water, and mixed with 98 grms. sulphuric acid, previously diluted with three to four times its weight of water. The liquid is well stirred, and let stand till the next day that the sulphate of baryta may settle. The clear liquid is then drawn off with a syphon, and evaporated down at a boiling heat in a porcelain capsule. When the liquid is reduced to one-tenth of its original bulk it is transferred to a platinum capsule, and a thermometer is suspended in the liquid (not touching the bottom) to regulate the temperature. The heat is kept first at about 105° C. A trace of a foreign body generally separates. The liquid is then filtered hot through washed paper, and returned to the platinum dish without being allowed to boil. After being heated for a quarter of an hour to 110°, the temperature is gradually raised to 130°, still avoiding ebullition. When it has been kept at this heat for about ten minutes the flame is withdrawn, the liquid cooled, and poured into a stoppered glass bottle.

Evolution of Heat in the Formation of Phosphorous Acid, Ortho-Phosphoric Acid, and Hypo-Phosphorous Acid from their Elements.—Julius Thomsen.

Evolution of Heat during the Formation of Arsenic and Arsenious Acids from their Elements Julius Thomsen.—These two papers cannot be usefully abridged.

Ortho-Cresol, and certain other Bodies of the Ortho Series.—A. Kekulé.—From otho-toluydin it is easy to obtain an iodo-toluol, which boils at 205° to 205·5° (211° if the whole column of mercury is immersed in the vapour).

Nitrophenol and Dioxybenzol.—H. Salkowski.—Not adapted for abstraction.

Identity of Walter's Moringic Acid with Oleic Acid.—K. Zaleski.—The so-called moringaic acid appears to be merely an impure oleic acid. The author remarks that in certain cases ultimate analysis fails to throw a satisfactory light on the composition of bodies without their derivatives and products of decomposition are studied.

Constitution of Phenyl-Bromethyl.—E. Bandrowski.—A hypothetical paper.

Explanation.—H. List.—A note bearing on the peucedanin controversy (No. x., p. 901).

Reply.—W. Weith.

Remarks on the above Reply.—A. W. Hofmann.—A continuation of the controversy on the desulphurisation of phenyl-mustard oil (See *Berichte*, vii., 523 and 814).

Gazzetta Chimica Italiana, Anno iv., Fascicolo 5, 1874.

Extraction of Sulphur.—F. Sestini.—If sulphur and gypsum, both finely pounded, are mixed and heated in a long test-tube in the oil-bath, when the temperature reaches to between 115° to 120° the sulphur melts, and the gypsum floats upon its surface. If the temperature is maintained for an hour within these limits, nothing further ensues beyond the occasional escape of a bubble of watery vapour, which condenses on the sides of the tube. But if the temperature is raised beyond 130°, the production of watery vapour is increased to such an extent as to form a kind of effervescence, whilst a faint odour of sulphuretted hydrogen accompanies the vapour. If the temperature is carried up to 165° the liberation of steam soon decreases as the liquid sulphur becomes viscid, and hinders the vapour from escaping freely. If sulphur and gypsum are heated in a covered crucible to 450° anhydrous sulphuric acid is formed, and sulphide of calcium remains. Thus, at 130°, the gypsum loses water and becomes anhydrous, whilst at higher temperatures the sulphur takes oxygen from the sulphate of lime. These phenomena have a practical bearing upon the extraction of sulphur by distillation, since the minerals often contain sulphur.

Action of Sulphur upon Earthy Carbonates, especially upon Neutral Carbonate of Lime.—Prof. Egidio Polacci.—In a former paper the author has shown that a mixture of sulphur and carbonate of lime, moistened with water and exposed to the air, becomes converted into sulphate of lime. He has now satisfied himself, by many experiments, that in certain natural circumstances sulphur may, by itself, combine with atmospheric oxygen so as to produce sulphuric acid. Besides carbonate of lime, other earthy carbonates may become converted into sulphates in contact with sulphur. He considers that if gypsum meets with carbonate of potash, soda, or lithia in the soil there is production of sulphates of potash, soda, or lithia, and of carbonate of lime: carbonate of ammonia decomposes it, and fixes ammonia by forming sulphate of ammonia and carbonate of lime. Gypsum converts into sulphates all the soluble alkaline carbonates, which is probably the origin of the alkaline sulphates met with in natural soils.

Chemical Researches on Turkey Red.—Professor Abelardo Romegialli.—This paper does not admit of abstraction.

Reports from the Œnological Station of Asti.—The report consists of papers on the quantitative determination of œnocyanin, by E. Grassi; experiments on the fermentation of must; an experiment on alcoholic fermentation; reply to a letter of Signor Negri, all by the same author; and a new method of determining glucose and tannin in wines and musts, by I. Macagno.

Reimann's Farber Zeitung, No. 37, 1874.

This number contains the commencement of a paper on dyeing ombrés and double ombrés; a continuation of the article on dyeing felt hats; Schlumberger's code of instructions for printing upon woollens, silks, and calicoes with his coal-tar colours; receipts for dyeing a brown and a Bismarck on silk goods with cotton warps; for a chamois, a dark brown, a black, a drap, and a bright fast pansy on wool; a brown on woollen yarn; a prussian blue on woollen cloth; a dark blue on "beiderwand"; and for printing a bright fast brown on cotton yarns and calico.

Meister Lucius, and Brüning's patent for the production of artificial alizarin is as follows:—Heat purified anthracen—melting-point 207° to 210°—in pans of earthenware or enamelled iron along with one-fourth its weight chromate of potash, and twelve times its weight nitric acid of the sp. gr. 1·05 for three hours. Dissolve the crude anthrachinon in 6 parts of boiling nitric acid, of sp. gr. 1·5. The solution is complete when no anthrachinon separates out on cooling. From this solution mono-nitro-anthrachinon is precipitated as a yellow deposit on adding water, and is washed, dried, mixed with 9 to 12 parts of solution of hydrate of soda, of the sp. gr. 1·4, and heated to 170° to 220°, until a portion withdrawn is found to give no additional precipitate when mixed with hydrochloric acid. The mass is then allowed to cool, dissolved in boiling water, filtered, and mixed with an acid which causes the colouring matter to be deposited as a yellowish brown sediment.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the preservation of meat or animal substances. John Garrett Tongue, of the firm of Tongue and Birkbeck, patent agents and engineers, 34, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Julius August Heinrich Damkoehler, Berlin.) February 9, 1874.—No. 505. This invention consists in first drying the meat at a temperature of about 35° to 60° R. until a thin coating or crust is formed all over it. It is then packed in cases containing hard dry salt, in which the meat is entirely imbedded.

Improvements in obtaining a white pigment, and in the process employed therefor. John Bryson Orr, manufacturing chemist, Glasgow, Lanark, N.B. February 10, 1874.—No. 517. The features of novelty which constitute this invention are—First. The production of a compound or combination of barium sulphate and zinc sulphide. Second. The chilling of the said compound or combination so as to increase its density, and impart body thereto.

Improvements in the manufacture and production of common salt, and in the apparatus employed therein. Frederick Bale, Government science teacher, Coventry Hospital, Droitwich, Worcestershire. February 10, 1874.—No. 521. This invention has for its object improvements in the manufacture and production of common salt, whereby a great saving in time and expense will be secured. This is accomplished by bringing the salt-cake and alkali manufacture into the common salt-making districts, and passing the hydrochloric acid evolved into the brine, and thus precipitating the sodic chloride or common salt.

Improvements in the manufacture of building materials and other similar products. Joseph Deléon, Boulevard de Strasbourg, Paris. February 10, 1874.—No. 525. This consists in producing imitation stone, marble, brick, as well as tiles and ceramic blocks of all kinds, by a composition of powdered limestone and sand with magnesia, chloride of magnesium, and carbonate of soda. These being all well mixed are moulded into the form desired, when the three last-named ingredients react chemically, and the whole mass becomes firmly aggregated.

Improvements in the manufacture of size. Thomas Blackburn, manufacturing chemist, Mellor, near Blackburn, Lancaster. February 12, 1874.—No. 540. My invention consists in combining chloride of zinc, or any other suitable salt of zinc, or salts of alumina or magnesia, caustic potash, sulphite of soda, or potash and water, either with or without farinaceous matter, or china clay, or soap-stone, or gum, or glue, or other adhesive substances.

Improvements in precipitating metallic copper from its solutions, and in obtaining a utilisable material from the agent employed for the purpose. John Thomson Duncan, accountant, Glasgow, Lanark, Scotland. (A communication from Thomas Sterry Hunt, Boston, Mass., U.S.A.) February 12, 1874.—No. 546. Tin-plate, scrap, or waste is used for precipitating copper from its solutions, and the adhering tin is saved. The copper solutions contain protochloride of copper, and a sulphate of soda or other base. The tin is recovered by its solution and precipitation as an oxide.

Improvements in the production of artificial fuel. Lieut.-Colonel Alexander Frederic Corbett, Doncaster, York. February 14, 1874.—No. 568.—The fuel is composed of 5 lbs. by weight of powdered charcoal, 6 lbs. clay or clayey earth, and 1 gallon of liquor, into which 6 or 7 lbs., dried cattle dung or peat have been stirred. These ingredients are added and mixed separately, and formed into a stiff paste mortar-like, and shaped by hand, or moulded, and dried.

Improvements in purifying alcohol, and in the apparatus employed therein. Comte de Beaurepaire de Louvagny, Boulevard de Strasbourg, Paris. February 17, 1874.—No. 591. This consists chiefly in purifying alcohol, while being distilled, of its etherous impurities by making use of the fact that ether volatilises at a lower temperature than alcohol. Air is pumped into a boiler containing the alcohol to be purified, raised to such a heat that the ether is volatile while the alcohol remains fixed, and the air bubbling through the liquid carries off the ether.

Improvements in the production of salicylic acid, and of the isomeric and homologous acids. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Prof. Hermann Kolbe, Leipzig, Saxony.) February 17, 1874.—No. 595. The essential features of this invention consist in the production of salicylic acid, and of other acids of the aromatic series, by the action of carbonic acid gas on carbolic acid, cresolic acids, or a mixture of them, in presence of alkalies or alkaline earths, or a mixture of them.

NOTES AND QUERIES.

Extracts of Indigo.—Could any of the contributors to your valuable paper give the readers of the Chemical News an article on the manufacture of extracts of indigo, as it is becoming an important article of manufacture in West Yorkshire? Works for its manufacture are increasing yearly.—F. Green.

Aniline Black.—Can you kindly inform me, through the medium of the Chemical News, of the simplest method of producing a *soluble* aniline black, to use for a writing ink? I have made nearly every other colour, but cannot succeed in getting a good black, the nearest approach being a dirty brown. I have made a green paste which turns blackish with NH_4HO, by treating aniline with $HCl + MnO_2$, but it will not dissolve in alcohol. Its best solvent (HCl) makes a green solution. —A. Percy Smith.

Arsenic Fluoride.—In reading Mr. Macivor's paper, "On Arsenic Fluoride," there is one point I cannot understand. How is it that in the reaction water is produced in the exact quantity to convert the AsF_3 into As_2O_3 and 6HF, and yet under these circumstances AsF_3 distils over, seeing that in the next sentence he says "water immediately decomposes it." I have tried to make it according to his formulæ, and with an excess of sulphuric acid, but I have failed in obtaining AsF_3. Would Mr. Macivor kindly explain the above?—N. T. Jones.

Elastic Composition.—Can you kindly assist me by telling, through your journal, how to render glue or gelatin permanently elastic, *i.e.*, not to shrink and get dry on the outside. I have heard it can be done by addition of glycerin, but, though I have tried several proportions, have not yet been successful; or that it can be attained by immersing the article in some chemical substance. Glue and treacle answers well for common dark work, but I want to make some much lighter. Or, if there is no means of using gelatin, &c., if you could give me a hint of the composition of the enclosed, or refer me to a work that I could find it in, you would much oblige me.—E. M.

MEETINGS FOR THE WEEK.

Monday, Nov. 2nd.—Royal Institution, 2. General Monthly Meeting.

Thursday, 5th.—Chemical, 8. Dr. C. Schorlemmer, "On Methyl-Hexyl Carbinol." Dr. C. R. A. Wright, "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids." Dr. J. L. W. Thudichum, "Further Researches on Bilirubin and its Compounds." Dr. Stenhouse, "Action of Bromine in the Presence of Water on Bromo-Pyrogallol and on Bromo-Pyrocatechin."

TO CORRESPONDENTS.

J. W. Mallet.—Received with thanks; it shall appear in an early number.

A Subscriber.—Wagner's "Chemical Technology," published by J. and A. Churchill.

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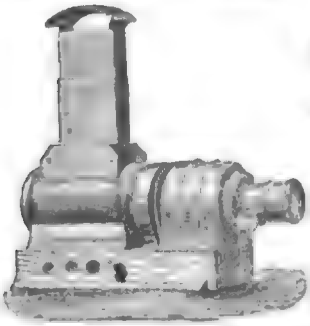

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THE CHEMICAL NEWS.

Vol. XXX. No. 780.

ANALYSIS OF BUFFALO BONES
AS COLLECTED FROM THE GREAT PLAINS OF AMERICA.

By J. W. MALLET,
Professor of Chemistry, University of Virginia.

Amongst the materials coming into commercial use for the manufacture of phosphatic manures are the dry and partially bleached bones of the buffalo (bison), annually killed in great numbers upon the plains of the interior of the American Continent, both by Indians and white men, many of these bones having, doubtless, lain exposed to the weather for very long periods of time.

A few months ago a sample fell into my hands of this material in a ground state, the fragments ranging from the size of a pea downwards. A carefully conducted analysis afforded the following results, which may be worth recording, as a little addition to our knowledge of bone as affected by exposure to the atmosphere. It will be seen that the amount of nitrogenous organic matter remaining is quite large, notwithstanding the brittle condition of most of the bone.

	As Received.	Dried at 105° C. Calc. for 100 parts.
Fat (dissolved out by ether) ..	0·721	0·788
Partially-altered osseine,* &c...	28·697	31·379
Calcium phosphate (tribasic) ..	49·437	54·058
Magnesium phosphate (tribasic)	2·307	2·523
Calcium fluoride..	0·438	0·479
Calcium chloride (calc. from Cl insol. in water)	0·124	0·136
Calcium carbonate (CO_2 directly determined)..	7·545	8·250
Calcium monoxide (Ca in excess of above-mentioned forms)	0·715	0·782
Sodium chloride	0·114	0·125
Potassium (chloride ?)	trace	trace
Sodium sulphate..	trace	trace
Iron sesquioxide..	0·096	0·105
Manganese	trace	trace
Insoluble (siliceous) residue ..	1·258	1·375
Water† (driven off at 105° C.) ..	8·272	—
	99·724	100·000

* Containing nitrogen—Bone as received, 3·971; dried at 105°, 4·342.

† Thermometer = 29° C, barometer = 746 m.m., when bone was weighed off for analysis.

University of Virginia,
Oct. 10, 1874.

ON THE DETERMINATION OF SULPHUR IN COAL AND COKE.

By W. F. K. STOCK, F.C.S.

It is proposed by Eschka (*Chem. Centr.*, 1874, 301) to determine sulphur in coal or coke by the combustion of the fuel by atmospheric oxygen, in contact with mixed sodium carbonate and magnesium oxide in a platinum crucible, and to secure the conversion of any other oxygen or sulphur compounds into sulphates by subsequent ignition with ammonium nitrate.

For three months prior to Eschka's communication, I had been endeavouring to devise a more satisfactory method than any of those in general use, such as oxidation by fuming nitric acid, fusion with mixed alkaline nitrates and carbonates, or deflagration with potassium nitrate alone, but pressure of business prevented me from completing my experiments earlier. After many trials attended with indifferent success, I eventually adopted the following, as being a process combining simplicity with rapidity and uniform accuracy of results:—

One grm. of coal or coke in fine powder and 1 grm. of pure lime are mixed in a platinum capsule 9 c.m. in diameter, having perpendicular sides 1·3 c.m. in depth, and weighing about 30 grms.; distilled water is then added in sufficient quantity to form a thin paste of the consistency of cream, and the whole stirred with a short glass rod until the operator is sure that every particle of the fuel under examination is in perfect contact with the solution of calcium hydrate. The capsule is now heated upon a thick cast-iron plate by means of a Bunsen's burner, and as soon as the mass becomes dry, which is speedily accomplished, it is stirred into a coarse powder, and heated to bright redness in a muffle for about twenty minutes, at the end of which time the whole of the carbon will have undergone combustion. The capsule is allowed to cool, and 3 c.c. of a concentrated solution of ammonium nitrate are added. In making this addition, care must be taken not to allow the solution to mix too freely with the assay, otherwise loss of substance is sure to result from the energetic action of the calcium oxide upon the ammonium salt. It is best to scrape a portion of the lime from the bottom of the platinum vessel, and to drop the solution gradually upon the bare spot from a pipette. The mass is again brought to dryness and heated to redness for five minutes, then cooled, dissolved in dilute HCl, and the sulphur determined as $BaSO_4$ in the usual manner.

In order to test the value of this process, a sample of Durham coke, known to contain about 1·5 per cent of sulphur, was taken, and the sulphur carefully determined three times by the old process of deflagration with potassium nitrate, and three times by the new lime process, and the following results were obtained, respectively:—

		Deflagration with KNO_3.	Combustion with CaO.
1.	Sulphur	= 1·450	1·440
2.	,,	= 1·380	1·440
3.	,,	= 1·510	1·450
	Mean	= 1·446	1·443

I believe the minimum in the results from deflagration to be due to overheating, and the maximum to presence of undecomposed nitrate in the solution, and consequent contamination of the $BaSO_4$.

This short note would be incomplete without my acknowledgment of the aid I have received from my senior assistant, Mr. W. Edwin Jack, in the performance of the many analyses I have found necessary.

Analytical Laboratory, Darlington,
October 27, 1874.

THE DISAPPEARANCE OF ORGANIC MATTER IN WATER RUNNING THROUGH IRON PIPES.

By A. WYNTER BLYTH, M.R.C.S., A.K.C., &c.,
Analyst to the County of Devon, Medical Officer of Health, &c.

The continuous oxidation of nitrogenous substances in ordinary running water freely exposed to air has been long known; but that organic matter disappears, and that water becomes purer, by simply running a certain distance in closed pipes, is, I believe, a fact not generally known, and of considerable importance to the sanitary engineer and hygienist.

Both the supplies given in the table are intermittent, and therefore it is possible that in places the pipes may be rusty, although I am assured that the glazed iron pipes used for water-mains do not rust; but, if they do, the puri fication would be easily explained. The samples, both of the Barnstaple and Ilfracombe supply, were taken in the same day. At Barnstaple, first R was carefully collected; we then walked slowly down to A, half a mile from R; from thence to B, half a mile from A; and from thence to C, half a mile from B. The last sample, C, shows a difference in total ammonia of 0·08 m.grm.; the nitrates are certainly not increased, rather the reverse. The Ilfracombe supply was sent to me by the urban sanitary authority, and was collected with great care in the same day. There is a remarkable difference between the same water before and after it courses through the iron mains.

	Solid Residue.						
	Organic and Volatile. Milli-grms. per litre.	Fixed. Milli-grms. per litre.	Total. Milli-grms. per litre.	Ammonia, Free. Milli-grms. per litre.	Ammonia, Albumenoid. Milli-grms. per litre.	Nitrogen, as Nitrates, &c. Milli-grms. per litre.	Chlorine. Milli-grms. per litre.
(1). *Barnstaple supply*—							
R. Reservoir after passing through the filter-beds ..	40·0	60·0	100·0	0·060	0·090	2·30	16·14
A.	40·0	60·0	100·0	0·040	0·080	2·00	16·14
B.	40·0	60·0	100·0	0·035	0·075	2·00	16·14
C.	39·0	60·0	99·0	0·010	0·060	2·05	16·14
(2). *Ilfracombe supply*—							
A. Taken directly after passing the filter-beds..	70·0	140·0	210·0	0·060	0·140	Not estimated.	21·43
B.	10·0	140·0	150·0	0·020	0·060	,,	21·43

Barnstaple, October 22, 1874.

NOTE ON A SAMPLE OF GENUINE BLACK TEA.

By A. WYNTER BLYTH, M.R.C.S., A K.C., &c,
Analyst to the County of Devon, Medical Officer of Health, &c.

It is well to accumulate evidence on genuine articles of food. In this short note I have nothing new to offer; its only value arises from the fact that the tea examined was grown upon my brother-in-law's (Dr. Shortt's) own plantation in India, and transmitted to me from Madras, so that all suspicion of adulteration is excluded. The assay confirms the analyses of Peligot, Wanklyn, and Allen, but the yield of ammonia from 100 m.grms. is rather higher than Mr. Wanklyn's average, who, I believe, puts it at 0·71 m.grm.

Genuine Indian Black Tea.

		The Tea taken in its ordinary state. Per cent.
Extract		33·900
Ash	Soluble 2·863 Insoluble 3·288	5·510
Tannin		11·500

Total ammonia yielded from 100 m.grms. of tea = 0·85 m.grms.

Barnstaple, October 30, 1874.

DETERMINATION OF AVAILABLE SULPHUR IN SPENT OXIDES.

By H. B. YARDLEY.

The following process for this determination has, I understand, been introduced by some chemist (?):—

A weighed portion is placed in an apparatus similar to that used in determining oil in oil-cakes, &c., by means of ether, using bisulphide of carbon in place of the ether, the matters dissolved out by the reagent being weighed as sulphur.

With a view to testing the accuracy of the above p cess, I have made four or five trials of it on different s ples, only one of which gave results anything near corr ness, the figures then being—

By nitric acid oxidation, 38·44 per cent total sulphur.
5·05 ,, sulphur as SO_3.
33·39 ,, available sulphur.
By bisulphide of carbon 33·72 per cent sulphur.

This sample, however, appeared remarkably free from tarry impurities, though the extracted sulphur was here slightly discoloured. In another sample, the bisulphide process, distilling over twice, gave 2 per cent too much, and distilling only once, 4 per cent too low; in each case the extracted *sulphur* being very dark-coloured, and when heated leaving a considerable carbonaceous residue, which was completely burnt on further heating in the blowpipe flame. This was a very dark, strong-smelling sample.

From these data, it would appear that this process perfectly unreliable. I have, however, found it extreme useful when, as often happens during oxidation with nitric acid, the sulphur is separated in small globules. The samples containing very often a quantity of organic matters, piece of sawdust, &c., not destroyed by the nitric acid, the weight of the globules cannot be determined by drying the insoluble residue, burning, and calculating the loss as sulphur. In these cases, the separated sulphur can be easily and quickly ascertained by extracting with the bisulphide, other matters soluble in the reagent having been destroyed during oxidation.

ON

BENZO-NITROTOLUIDIDE, AND THE ACTION OF REDUCING AGENTS UPON IT.

By CHICHESTER A. BELL, M.B.

In Chemical News, vol. xxix., p. 167, I described an attempt to produce, by the action of alcoholic ammonium sulphide on benzo-nitranilide, the oxygen-free base—

$$\left.\begin{matrix} C_6H_4'' \\ C_7H_5''' \\ H \end{matrix}\right\} N_2,$$

analogous to the compounds described by Hobrecker* under the titles ethenyl-diamido-toluol and ethenyl-diamido-xylol, obtained by the action of nascent hydrogen on acet-nitramido-toluol and acet-nitramido-xylol. The attempt was unsuccessful; the nitranilide simply passed into a phenylen-diamine, the benzoic radical remaining unchanged.

In the hope of effecting reduction of the benzoyl group also, I have since submitted benzo-nitranilide to the action of nascent hydrogen developed from tin and moderately concentrated hydrochloric acid. On heating the mixture for some time, filtering while hot, and allowing to cool, handsome crystalline tufts of a double chloride were deposited. Through the diluted solution sulphuretted hydrogen was passed, so as completely to remove the tin, the filtrate concentrated, and treated with caustic potash. From the resinous precipitate thus obtained, the base was extracted by boiling-water and purified by repeated crystallisations. Its identity with that previously obtained (by the action of ammonium sulphide) was established by its fusing-point (125° C.), and by a platinum determination in its platinum double salt. Calculated for—

$$2\left(\left.\begin{matrix} C_6H_4 \\ C_7H_5O \\ H_3 \end{matrix}\right\} N_2.HCl\right).PtCl_4 = 23·77 \text{ per cent.}$$

Found = 23·45.

Hobrecker, in his experiments on the fatty derivatives of the aromatic nitramides, was unable to reduce the acetyl

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* Hobrecker, *Ber. der Deutsch. Chem. Gesell.*, 1872, p. 920.

T in nitracetanilide, but succeeded in the case of ceto-toluidide. I have, therefore, formed a benzo-toluidide, and submitted it also to the action of cent hydrogen. As I have been unable to find any cription of this body, I give a brief account of its propers.

Benzo-nitrotoluidide is readily formed when benzoyl-loride is allowed to act directly, at a gentle heat, upon nitro-toluidine (fusing-point, 77·5° C.). The reaction proceeds, however, much more smoothly when the two bodies are brought together in anhydrous ethereal solution. The amide is thus almost completely precipitated, whilst nitro-toluidine hydrochlorate remains in solution. After removal of the ether by evaporation, the latter compound must be extracted by boiling-water, and the residual benzo-nitro-oluidide purified by repeated crystallisations from boiling lcohol. It is thus obtained in delicate pale yellow prisms, hich, on heating, transiently assume a deeper colour. melts at 172° C., and by very cautious heating may be blimed unaltered. It is insoluble in water, slightly luble in cold alcohol, ether, and benzol, readily so in these liquids when boiling. Neither dilute acids in general, nor strong hydrochloric acid, will dissolve it. Cold sulphuric acid takes it up freely; from this solution it is deposited unaltered on dilution. Even prolonged boiling with strong soda-lye fails to decompose it to any extent; alcoholic potash and boiling concentrated acids readily act upon it. Analysis yielded the following results:—

	Theory.	Found.
C	65·62	65·50
H	4·69	4·91

The reduction was accomplished by tin and hydrochloric acid, exactly as in the case of benzo-nitranilide, and with precisely similar results. Any attempt to carry it farther, either by prolonged heating, or by using a highly concentrated acid, results in the formation of toluylen-diamine and free benzoic acid. Like its homologue, benzoyl-toluylen-diamine is very soluble in alcohol and ether; boiling-water takes it up sparingly, and deposits it on cooling in transparent colourless prisms which melt about 142° to 143° C. It is readily soluble in dilute acids; hot concentrated acids decompose it. Analysis gave the following results:—

	Theory.	Found.
C	74·33	73·89
H	6·19	6·53

Unfortunately, the quantity of substance at my disposal did not admit of its being obtained in a state of absolute purity.

Thus, in these two instances, the attempt to reduce the benzoyl group was unsuccessful. The failure might, perhaps, have been foreseen. In fact, the monatomic group (C_7H_5O) would, by reduction, become triatomic, $(C_7H_5)'''$, and in a phenylen- or toluylen-diamine must be directly connected with both atoms of nitrogen. Now, Hobrecker and Hübner and Retschy[*] have experimented with nitramides produced by the direct nitrification of the corresponding amides, and in these compounds it is generally admitted that the nitro and amido groups occupy contiguous positions in the molecule; whilst in para-nitraniline and para-nitrotoluidine, which I have employed, the two groups are widely separated. Hence, the existence of triatomic radicals would be possible in the diamines obtained by reduction of the former class of compounds, but impossible in those derived from the latter.

It is my intention to extend these experiments to derivatives of ortho-nitraniline, containing other radicals than those of the fatty and benzoic series.

Steevens's Hospital Laboratory, Dublin.

Glasgow Veterinary College.—Dr. R. Carter Moffat has been awarded a Gold Medal and Diploma by the Italian Government in recognition of the industrial investigations and discoveries made by him in Italy recently.

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[*] Hübner and Retschy, *Ber. der Deutsch Chem Gesell.*, 1873, p. 798, 1128.

ON ANTHRACEN AND ALIZARINE.[*]

By FREDERICK VERSMANN, Ph.D.

(Continued from page 204.)

Having thus obtained the anthracen by one method or the other in a saleable form, we may next consider the method of determining its marketable value, and here I come to the most unsatisfactory part of the whole subject, a part which I am anxious to thoroughly ventilate.

In other commercial analyses the results obtained by the chemist, in almost all cases, is expressed in percentage of a definite, pure, chemical compound, from which, by simple calculation, the real and exact value of the merchandise is ascertained; no room is left for manipulating the analysis or for introducing modifications, by which the result is affected. This is unfortunately not the case with the anthracen tests. I have already drawn attention to the difficulty of the manufacturer has to contend with in separating the one hydrocarbon from the whole series, and if this is the case on the large scale, the difficulties no doubt increase with a laboratory experiment, and the chance of really trustworthy quantitative determination becomes almost hopeless. I repeat, the impurities which influence the value of the article are in all their physical properties so similar to anthracen itself, that it is impossible to effect a complete separation, either by solution, sublimation, or other mechanical means; nor do we know as yet of a convenient and entirely satisfactory process by which anthracen might be converted into a definite and distinct chemical compound, different from analogous products obtained from the impurities.

A short account of the usual anthracen tests will bear out my opinion. The first few parcels of anthracen were sold without any analysis whatever, and perhaps neither buyer nor seller knew what kind of bargain he had made, but soon the German alizarine makers looked up the tar distillers all over the country, and it became necessary to adopt some kind of test for determining the quality and value of this new product.

Dr. Gessert, of Elberfeld, in first introducing the alcohol test, was guided by the just opinion that the commercial value of a sample might be ascertained with sufficient accuracy by determining the percentage of hydrocarbon insoluble in alcohol, together with its melting and solidifying point. The details of the test are as follows:—

ALCOHOL TEST.

Take 20 grammes of the well-mixed sample, heat it in a beaker glass with 150 per cent of alcohol, sp. gr. 825, till it gently boils; then cool it to 15° C. (59° F.), bring it on a filter, and wash with so much alcohol that the filtrate measures 400 per cent. Dry the filter and residue in a water bath, detach the residue from the filter, and weigh; the weight multiplied by 5 gives the percentage. Mix the weighed residue well in a mortar, and introduce a small quantity into a narrow glass tube, about four inches long and one-sixteenth internal diameter, and drawn to a point at one end; fix the tube and a delicate thermometer into a small paraffin or ozokorite bath, which heat gently and gradually. Note the moment the anthracen becomes liquid, *i.e.*, when the first drop collects at the end of tube; this is the melting-point. Now increase the temperature to about 220° C., remove the flame, and note the moment the liquid becomes solid again, this is the solidifying-point, which with good samples should be nearly the same as the melting-point; the mean of the two is the final point.

Now, we know pure anthracen melts and solidifies at 213° C., and in order to make the test really accurate, the percentage of insoluble should be of such quality as to melt exactly at that temperature; but even then it might not be pure anthracen, because some of the impurities have a lower and others a higher melting-point, and a mixture of the two might melt at 213° C. This, however, is a question which need not be considered, because such a mixture would show a wide difference in the melting and solidifying point, while with a pure, definite compound they should be very nearly the same. The determination of the melting-point altogether is an operation demanding great attention. First of all, a very delicate thermometer is required, and none should be used without previous comparison with a standard thermometer; very few instruments are so exact as not to require a correction, sometimes of several degrees, both in the rise and fall of the mercury. Then, again, the melting-point of these hydrocarbons, especially in small quantities, often varies in like manner as that of sulphur, consequent to a change in the condition they have assumed by previous melting, more or less strong heating, or more or less rapid cooling.

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[*] Read before the Society of Arts, Chemical Section.

But, nevertheless, although the alcohol test cannot claim anything like analytical accuracy, it may form a guide in fixing the approximate value of the article, provided the details of the test always remain the same.

The true melting-point of 213° C. was never insisted upon, but its maximum was first fixed at 200° C. Competition soon lowered to 195° C., and ultimately to 190° C., at which it now stands, *i.e.*, the present alcohol test means the determination of per cent of insoluble in alcohol, having a melting point of at least 190° C.

Of course, everybody knows that is not pure anthracen; still the test might be sufficiently accurate for comparative experiment, if always carried out in the same manner.

But now mercantile speculation and cleverness steps in and suggests trifling modifications for its own benefit. Knowing that the less anhydrous the alcohol is, the less it will dissolve, or, in other words, the higher the percentage of insoluble will be, several ingenious people have their test made with alcohol of 830, 835, or sometimes even of 840 sp. gr.

Again, an impure sample may have a melting-point much below 190° C. Then the chemist is often expected to take, not the actual proportion of alcohol, but an indefinite quantity, sufficient to bring up the melting-point to 190° C.

In such cases the analyst is, of course, helpless; he has simply to follow the instructions he may receive, and any protest of his would perhaps have no other effect than the loss of a client.

The reason for using alcohol of half-a-dozen different specific gravities is obvious; the percentage of insoluble may thereby be increased or decreased. But such tricks and manipulations should not be tolerated; they throw doubt and confusion upon all transactions, and undermine the value of chemical analysis altogether.

Some time after the alcohol test had been adopted, the bisulphide of carbon test was introduced, which is as follows:—

"Bisulphide of Carbon Test.

Take 10 grammes of the well-mixed sample, place it in a wide mouth stoppered bottle, together with 30 c.c. of bisulphide of carbon, shake up well and allow to stand for one hour at a temperature of 15° C. (59° F.); then bring the mixture on a filter, wash with 30 c.c. more bisulphide of carbon, and gently press the filter so as to dry it as much as possible; then dry completely in a water-bath, detach the residue from filter and weigh; the weight multiplied by 10 gives the percentage. The melting and solidifying points are taken as above."

The principle of this test is so far the same as that of the alcohol test, viz., that the impurities are more soluble in the liquid than anthracen, and may thereby, partly at least, be removed. We find bisulphide of carbon much more active than alcohol, and on treating one and the same sample with both tests, alcohol invariably yields a higher percentage of insoluble with a lower melting-point, while bisulphide gives a lower percentage with a higher melting-point. There is no fixed relation between the two results. The product of the bisulphide test seldom has a melting-point below 200° C., while with alcohol very few samples indeed show so high a melting-point. The result of the bisulphide test is therefore much purer, and ought to fetch a higher price; but as no definite rule can be adopted, the constant mixing up of the two tests is another source of confusion.

(To be continued).

NOTICES OF BOOKS.

Causeries Scientifiques. By Henri de Parville. Paris: J. Rothschild.

There are obviously two methods of compiling an annual record of discoveries and inventions. The one, preferred in England, consists in stringing together a number of paragraphs *au naturel*, if we may use the expression, just as they are found in scientific journals and in the transactions of learned societies. The other, adopted in the work before us, takes the original bare announcements of facts as its text, and seeks to weave them into a connected discourse. If the former plan be the less troublesome, the latter certainly produces a more readable book.

Turning, as is natural for us, to the chemical portion of the work, we find that especial attention has been given to ferments in the widest sense of the word. The germs and cells, which, when introduced into the system occasion zymotic disease, and those which play a part both in the manufacture and in the subsequent decomposition of wines and beers, have lately attracted much of the attention of French chemists. The following passage is a good popular view of the action of putrescent organic matter in water:—

"How does organic matter become dangerous? We must not believe that it constitutes, as is superficially said, a toxic element. The phenomenon is more complex. The organic matter in suspension or in solution creates in the water a peculiar medium, suitable for the development of exceedingly small beings of the genus Vibrio. It is no longer mere water—it is a world of microscopic animals and plants which are born, live, and increase with bewildering rapidity. The Infusoria find in the water calcareous, magnesian, and ammoniacal salts, and their maintainence is thus secure. Drink a drop of this liquid and you swallow millions of minute beings. But there are vibrios and vibrios. There are those which are capable of setting up putrefaction in our tissues. These are our enemies, often our mortal enemies. Let a water be placed in contact with organic remains capable of nourishing these malignant vibrios, and it at once becomes more dangerous than any poison."

The author points out that, according to the researches of the late Dr. Calvert, charcoal, lime, and permanganate of potash, contrary to the received opinion, facilitate putrefaction and actually promote the formation of animalculæ. Charcoal when used for the purification of polluted waters, undoubtedly absorbs into its pores offensive gases held in solution, as well as liquid colouring and flavouring matters. It can render such waters colourless and tasteless. But upon living animalculæ and their germs it is absolutely powerless. Nay, water containing a known amount of "albumenoid ammonia" when experimentally filtered over animal charcoal, has been found on analysis worse than before. Permanganate of potash may oxidise—in fact, burn up—dead organic matter suspended or dissolved in water; but upon living organisms it is almost powerless. We have seen animalculæ remain in full life and apparent vigour for hours in water to which permanganate had been added in a large proportion. M. Davaine found that putrid blood after treatment with charcoal became more poisonous than before. It is possible that the gases dissolved in the liquid hinder the development of the Infusoria. The author considers carbolic, or better still cresylic acid, as the only agent which extirpates these animalcules. According to Wœhler, alumina in the gelatinous state precipitates the dissolved animal matter which serves as a pabulum for these minute animal and vegetable beings. The experiments of M. Davaine on the power of antiseptics to destroy the virus of carbuncle belong rather to medicine than to chemistry. Solution of iodine seems the most effectual remedy.

The author quotes the recent researches of M. Eug. Peligot, showing that common salt is not a fertiliser as it is generally considered, at least for the majority of plants. But though sodium compounds are not as a rule absorbed by vegetation, further experiments are needed before we can legitimately pronounce them useless. The many instances in which a dressing of common salt has produced beneficial effects seem to indicate that it may be indirectly useful by promoting the solution or the decomposition of other bodies.

Liquorice-root is recommended as means of rendering quinine, colocynth, aloes, and other bitter medicines inoffensive to the taste. Unfortunately there are some persons to whom the remedy would be worse than the disease.

Glycerine is recommended to prevent incrustations in steam-boilers. It not only dissolves a large amount of the calcareous salts present, but it causes the residue to be deposited in a form in which they are incapable of attaching themselves to the metal.

This volume is, in short, a pleasant, chatty fire-side companion, which imparts a large amount of useful knowledge in a lucid and popular manner.

CORRESPONDENCE.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—The author of the article (CHEMICAL NEWS, vol. xxx., p. 199) "On the True Relation between the Weights, Volumes, and Specific Gravities of the Component Elements, and those of the Compound, in Chemical Combinations," apparently makes no claim to being himself a chemist, for he says he sought for information "in works of reference and from reputed chemists." He is probably a mathematician, and, happy only in applying the deductive methods of his science, he is careless about that preliminary verification of his data which is an object of so much solicitude to the merely experimental philosopher. It is not surprising that strange discrepancies result from calculations in which the specific gravity (air = 1) of oxygen gas is taken as 1·6. When the true number (1·105) is substituted for the erroneous one, all the alleged contradictions vanish. In another calculation, into which the erroneous value does not enter, a curious slip occurs. The statement asserting the *equality* of the volumes of the imaginary gases before and after combination, in the reaction $C+CO_2=2CO$, is thus transcribed into an equation for the calculation of the density of carbon vapour:—

$$\left\{\frac{C}{x}+\frac{C+2O}{1·529}\right\}:\left\{\frac{2(C+O)}{0·9706}\right\}=1:2.$$

The fallacy here is about the same as making $1+1=1$, and the value of x, so found, is of course somewhat perplexing. When the equation is written in accordance with the statement that "1 volume of carbonic acid added to [combined with] 1 volume of carbon vapour formed 2 volumes of carbonic oxide," the solution gives $x=0·414$, which figures represent the density of the hypothetical vapour of carbon, on the supposition that the molecular formula of the element in the state of gas is C. It appears strange that the author's results did not lead him to suspect some inaccuracy in his data, or in his deductions, instead of forcing him to the alternative conclusion that there must be some unrecognised fallacy lurking in the fundamental teachings of chemical science.—I am, &c.,

R. ROUTLEDGE.

London, October 31, 1874.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—In your last number is a paper by Sir F. C. Knowles, calling attention to certain discrepancies between results commonly accepted and certain corrections proposed by the writer. He has, however, used a wrong value for the density of O; relation to air as unity, the density is 1·1 nearly. On substitution of this value in the formulæ, the anomalies noticed by the author will disappear.—I am, &c.,

JAMES BOTTOMLEY, D.Sc.

Taunton College School,
Taunton, Nov. 2, 1874.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—On carefully looking over the paper on the above-mentioned subject, by Sir F. C. Knowles, Bart., F.R.S., in your last week's issue, I was naturally at first somewhat puzzled at the discrepancies which resulted from his calculations relative to the volumes and specific gravities of CO and its component gases. On, however, reading it a second time, I have, I think, arrived at the solution of the problem. The author assumes, as the specific gravity of O compared with air, the figures 1·6, whereas the true specific gravity of that gas (calculated on the same basis as yields 0·9706 as the specific gravity of CO) is 1·109. If, therefore, he will re-write the equations which follow, substituting in all cases the number 1·109 for 1·6 as the sp. gr. of O, he will, I think, find that the paradoxical results which he obtained will entirely disappear. Thus the formula $\frac{C}{O}$, deduced from both series of equations, will be found to give the figures 0·750 in each case, instead of 0·21325 in the one and 0·750 in the other, as stated.—I am, &c.,

A. S., B.D.

London, November 3, 1874.

NOTE ON SULPHINDIGOTIC ACID.

To the Editor of the Chemical News.

SIR,—The following instance of spontaneous decomposition may interest some of your readers. A solution of commercial sulphindigotic acid, after keeping several years, was observed to be turning green. It finally became of a fine chrome-green colour, and a purple precipitate fell. The purple residue, when filtered off, dissolved in water to a blue solution. Sulphurous acid dropped upon the solid precipitate produced no change. This substance seems to be the sulpho-purpuric acid obtained by Berzelius by the action of alkalies on sulphindigotic acid, to which the formula—

$$\left.\begin{matrix}C_8H_5NO\\C_8H_5NO\end{matrix}\right\}SO_3$$

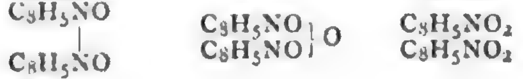
is generally assigned.

The clear chrome-green solution was found to shorten the violet end of the spectrum very considerably. Barium chloride gave a slight dirty-white precipitate. Bromine-water and potassium dichromate instantly decolorised the solution in the cold; dilute nitric acid only on boiling. Sulphurous acid instantly changed the solution from clear chrome-green to indigo-blue. The solution was evaporated to dryness on the water-bath; the amorphous green residue was very soluble in water, and also in alcohol.

When a dilute solution of sulphindigotic acid is mixed with one of hydrogen dioxide, no change takes place; but, if two or three drops of a dilute solution [illegible]ium dichromate be added, oxygen is evolved [illegible] of the solution changes to chrome-green, a[illegible] a purple precipitate falls.—

This green substance appears to be identical with the sulpho-viridic acid obtained by Berzelius as the first product of the action of alkalies upon sulphindigotic acid. It is probably the compound of a body intermediate between indigo-blue and isatin with sulphur trioxide—

Indigo. Isatin.



$$\begin{array}{c} C_8H_5NO \\ | \\ C_8H_5NO \end{array} \qquad \left.\begin{array}{c} C_8H_5NO \\ C_8H_5NO \end{array}\right\} O \qquad \begin{array}{c} C_8H_5NO_2 \\ C_8H_5NO_2 \end{array}$$

—I am, &c.,

Sidney Lupton.

October 31, 1874.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—The various and vexatious differences that buyers and sellers are constantly meeting with in the analyses of phosphatic and similar materials are sources of great pecuniary loss to some of the parties in the transactions, fertile fields for disputes opening the door to all sorts of suspicions, and more than enough to raise a doubt, in the minds of those not engaged in chemical manipulation, as to the probability, or even possibility, of an accurate analysis by chemical means.

Is not the matter within the control of those interested? With the view of showing that it is, I suggest the following; and, whilst aware that the plan is not perfect, shall be glad if the subject is thereby more fully considered and some satisfactory decisive steps taken.

Let the principal shippers, agents, manufacturers, and buyers form an "Analysis Association" amongst themselves, employing their own chemists, demanding from these a good standard of accuracy, giving to each a liberal remuneration as incentives to carefulness, placing or not placing the result of each chemist in check with those of another; preventing any influence for "high" or "low" results, by the chemists receiving samples only through a reliable officer; and samples, when handed to the chemists, being simply numbered, or otherwise distinguished without names; making each chemist responsible for every analysis he does, by requiring his report signed by himself, and all results to have been obtained by his own personal work.

If one of the principal firms interested issue a circular to others for the above object, and receive a sufficient number of assenting replies, let a meeting be called to formally commence the Association, then some well-known chemists be engaged to act as an examining body. Let invitations be published for candidates to undertake the duties of such analysts, and the examiners then test each candidate in such a way as to ascertain that he is by experience acquainted with the subject, and is a reliable worker. Of the candidates found worthy of confidence, let the examiners appoint one, and, supposing the Association to engage two analysts, report who of the remaining candidates are reliable men; from these let the Association appoint the other analyst. Should more than two be appointed, but still an even number—say, for example, four—let the examiners appoint half, and the Association half; if there be an odd number, then the greater number be appointed by the examiners.

The Association commenced, and the analysts appointed, let a careful person be selected as clerk, to receive samples, make entries of them, and hand them to the analysts, receive analytical reports, and forward them to those whom they concern.

The analysts to receive samples only from the clerk, with simple marks on the samples, seeing that the bottles, seals, &c., are uninjured; to give their attested results to the clerk for delivery; to undertake no other analyses, but give their whole working time to the analyses of the Association; to keep for reference at least half of each sample in case of dispute; in no case to destroy a sample till a year old; to provide their own separate laboratories out of their salaries; and to be paid quarterly.

Persons sending samples for analysis to abandon the present custom of placing particulars of name, ship, quantity, date, &c., on samples, and to agree between themselves upon some distinguishing mark for their samples. To send samples for one or two analysts, as they wish, but if sending to two, then to accept the mean of such two analysts' determinations; unless the differences be beyond a certain limit, to be previously fixed, in which case samples to be obtained back and referred on. For the purpose of such references, the various manufacturers, &c., would not, I am sure, impose too harsh a limit on the differences of manipulation; so that the analysts would not fear frivolous complaints on account of differing results, whilst, of course, they must undertake their posts with the limits allowed for differences previously pointed out, and in each case of difference the chemist decided to have been wrong to pay the fees for such reference analysis. To facilitate such references, let each analyst on his appointment, and afterwards at every six months, name, in common with the others, some chemist by whose results he will abide, such reference chemist's analysis to be taken as confirming that analyst's results whose he most approaches, and negativing that analyst's results he most differs from.

The salaries of the analysts I would propose to be £800 per annum, and of the clerk £200; for an office, one room would suffice; and with a staff of two or three chemists the expenses would be £2000 to £3000 per annum, which sum, if divided over the total weights of materials passing through manufacturers' hands, would not amount to more than a few pence per ton.

It is, of course, supposed that the firms who have private chemists will retain them, and that only the ordinary samples between buyer and seller are the objects of the Association.

By giving the analysts liberal salaries, and placing or not placing each in check with another, there will be sufficient inducement to skilful work; whilst the payment of reference fees by the erring chemist, and the partial discredit if adjudged wrong, will, I believe, reduce results to a fair degree of accuracy, and make cases of reference rare. Should, on reference, the samples be found different, so as to account for differing results, then the analyst should not be held to be in the wrong, and the principals who forward the samples at first to pay reference fees.

To equalise the influence of the Association members, according to their interests therein, let one vote in all matters be given to each member for, say, every £25 of yearly subscription, and, so that one member shall not obtain an undue proportion of work from the Association, let each sample sent in by a member be debited to him at a fixed rate; then, at end of year, if any member has exceeded his proportion in comparison with his subscriptions, or has not required them all, he will have to pay additional, or else be credited proportionately on the next year's subscription.

Non-members sending samples to pay the Association ordinary fees for such analyses, and the fees to become the property of the Association, not the chemist's.

The foregoing to be embodied in the prospectus and rules of the Association, with such other details as shall be found advisable.—I am, &c.,

M. C.

ANTHRACEN ANALYSES.

To the Editor of the Chemical News.

Sir,—In the Chemical News of the 23rd inst. we notice a paper from the pen of Mr. R. Lucas "On the Testing of Crude Anthracen," he giving results nearly similar to those we have obtained, and which we hope shortly to publish.

In speaking of Luck's anthrachinon test he says, "I have experimented upon the following admixtures of crude anthracen:—Napthalin, acenapthen, phenanthen, carbazol, pyren, chrysen, and benzerythren. All these tar products submitted to the anthraquinon test were transformed into substances soluble in dilute alkali."

We beg to ask Mr. Lucas whether he operated upon the absolutely pure products above mentioned, and if so, where information may be found relating to their preparation and purification. Our reason for asking this is, that we have been working upon the methods for testing anthracen for the past twelve months, and feel interested in an answer to this query.—We are, &c.

George E. Davis.
T. H. Davis.

St. Helens, Lancashire,
October 28, 1874.

FERROUS SULPHIDE IN CHARCOAL.

To the Editor of the Chemical News.

Sir,—In your last number there is a letter signed "R. Speirs." He asserts—(1) That the presence of FeS in char was "supposed" by himself, from certain analyses made by him two years ago; (2) that he examined the deposit at a subsequent period; (3) that his supposition and examination were communicated to me.

As to the first, I do not claim in my paper to be the originator of the idea that FeS exists in char; Muspratt announced it long ago in his article upon bone-black. No analyses exist which *prove* the fact, Mr. Speirs's assertion nevertheless.

(2). No more did I claim the kiln-pipe deposit as a discovery of mine. I expressly said that it occurred more or less in all houses. When found in excessive amount, it is the result of gross overheating. For obvious reasons, it would not have been courteous to associate the name of one who had the oversight of kiln-pipes with such a substance. Although others have seen the interesting stranger, as well as Mr. Speirs, in other refineries, no one can object to his claiming its paternity, and "Speirs's Pipe Deposit" will keep fresh in our memories a relic of the sulphur age.

(3). My paper was an attempt to *prove* (not to suppose) that FeS was the char sulphide. The deposit does *not* prove that, but my experiments quoted I respectfully submit do. For these I am solely indebted to myself. The analyses given of "Speirs's deposit" were done by my assistant and myself. The ideas of the *experiments* originated every one from me. What Mr. Speirs may have said to others he knows best himself; but if he has asserted that he was the author of a single experiment, or did one figure in the paper, or communicated the slightest information to me on the subject, he is not only "uncourteous," but guilty of something else.—I am, &c.,

R. Frazer Smith.

Greenock, October 31, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 12, September 21, 1874.

Sulpho-Carbonate of Baryta.—P. Thenard.—The interest taken in the sulpho-carbonates since they have been applied by M. Dumas to the destruction of the phylloxera has drawn attention to various methods for their preparation. If we agitate, for a few minutes only, a solution of sulphide of carbon, ever so little concentrated with sulphide of carbon, there is quickly deposited a canary-yellow powder, crystalline, and very dense, which is pure sulpho-carbonate of baryta. The purification consists merely in washing in alcohol to remove excess of sulphide of carbon, followed by desiccation in a vacuum. On the large scale, the process is also very simple. Taking the mother-liquor left from a former operation, we pour into it a solution of sulphide of barium, as hot and concentrated as possible, until the temperature rises to 15° to 18° above the atmosphere, but does not exceed the maximum of 40°. Into a certain quantity of this mixture we pour a dose of sulphide of carbon, less than what it can absorb, and stir the mixture briskly from time to time for a period of five to six hours, or rather, till the smell of sulphide of carbon has sensibly disappeared. The whole is then poured into one of the settlers where the sulpho-carbonate is intended to accumulate. As it deposits and accumulates rapidly, it is very easy to decant the liquid after the lapse of twenty-four hours. The water thus run off is then treated with a fresh dose of sulphide of carbon, relatively in large excess. The stirring this time is kept up for twelve to fifteen hours, with intervals of rest as before. A fresh amount of sulpho-carbonate is deposited at the bottom of the vessel. The liquid is then run off, taking care not to pour away the sulphide of carbon in contact with the precipitate. The water drawn off is the mother-liquor, properly so-called, used at the outset of the operation. This mother-liquor having been decanted off, is replaced by the mixture of sulphide of barium and mother-liquor of the sulpho-carbonate, and agitated as before until all the sulphide of carbon has been utilised. It is, however, desirable to convert the sulpho-carbonate of baryta into the corresponding potash salt, both because the latter is more soluble, and because potash is beneficial to vegetation, whilst baryta is probably destructive.

New Mercurial Pneumatic Apparatus.—M. de Las Marismas.—The structure of the apparatus cannot be made intelligible without the accompanying diagram. It is said to have the following advantages:—It is easily constructed and inexpensive, not costing more than 35 frs. It is rapid in action, and does not fatigue the operator. A vacuum is obtained at about 1 millimetre, in a receiver of 6 litres in four minutes. Experiments can be made at all pressures between that of the atmosphere and an absolute vacuum. It works automatically, and avoids all the errors which may happen with mercurial pneumatic machines where the taps are moved by hand. It holds its vacuum for an indefinite length of time.

Action of Alimentary and Medicinal Liquids upon Utensils of Tin containing Lead.—M. Fordos.—The author has examined the alloys of tin and lead used in the manufacture of divers vessels and utensils, and in tinning culinary apparatus, and has obtained very important results. It appears that an alloy of tin is used in hospitals, pharmaceutical establishments, &c., containing 10 per cent of lead. This is easily attacked by vinegar—even if much diluted—wine, lemonade, &c., and a notable and dangerous quantity of the poisonous metal.

Researches on the Colouring Matters of Madder.—A. Rosenstiehl.

Further Experiments on the Nature of the Sulphurous Principle of the Waters of Luchon.—M. F. Ganigot.—When these waters are desulphuretted by sulphate of lead, perfectly neutral, they become acid.

Luminous Diffusion.—A. Lallemand.—Not adapted for abstraction.

On Warwickite.—J. Lawrence Smith.—Professor Shephard, who first described this mineral, confounded two distinct substances—warwickite, properly so-called, in small slender crystals, and an impure variety of the same crystalline form, but containing merely a small portion of the true mineral. Later, Prof. S. Hunt gave the name enceladite to the impure variety, whose composition he gives as—

Titanic acid	31·5
Magnesia	43·5
Ferric oxide	8·1
Loss on ignition	2·0
	85·1

The author's analysis of the mineral, carefully selected, and freed as far as possible from crystals of spinel, is—

Boracic acid	27·80
Titanic acid	23·82
Magnesia	36·80
Ferrous oxide	7·02
Silica	1·00
Alumina	2·21
	98·65

The silica and alumina are impurities, the latter derived from spinel. The titanic acid contained a trace of iron. The composition of the mineral appears therefore as—

$$3\dddot{\mathrm{B}}\mathrm{o}+2\ddot{\mathrm{T}}\mathrm{i}+6\dot{\mathrm{M}}\mathrm{g}+\dot{\mathrm{F}}\mathrm{e}, \text{ or } \dot{\mathrm{M}}\mathrm{g}_5\dddot{\mathrm{B}}_3+(\dot{\mathrm{M}}\mathrm{g}\dot{\mathrm{F}}\mathrm{e})\ddot{\mathrm{T}}\mathrm{i}_2.$$

It is the only boro-titanate occurring in nature. In the same locality is found a titaniferous iron containing 15 per cent of magnesia, which, according to Rammelsberg has the formula—

$$\dot{\mathrm{M}}\mathrm{g}\ddot{\mathrm{T}}\mathrm{i}+\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{T}}\mathrm{i}.$$

Moniteur Scientifique, du Dr. Quesneville, September, 1874.

The Sulphur Industry of Sicily.—Sulphur in its natural state is found in many parts of the globe, but nowhere (?) in so great plenty as in Sicily. It was found first as a deposit resulting from recent volcanic eruptions —called in Italy solfatare—and afterwards deep-lying beds, where it is associated with sedimentary rocks (solfare). The amount of native sulphur furnished by the former is very trifling. Pouzzali, near Naples, is at present abondoned. Vulcano, in the Lipari Islands, yields 200 quintals of 100 kilos. yearly. The mines of sulphur, strictly so-called, have a far greater importance. Except in Italy, the chief are those of Radoboy in Croatia, Szwoswice in Gallicia, Czarkow, the Isle of Milo, Apt in the Vaucluse, Murcia. Bohar on the Red Sea, &c. The sulphur mines of the Romagna produce yearly more than 120,000 quintals. The Sicilian mines yield 180,000 tons of crude sulphur, without reckoning the enormous amount wasted by the treatment of the ore. The mines are scattered in the provinces of Caltanisetta, Girgenti, and Catania, besides two isolated beds, those of Lercara in the province of Palmero, and of Gibellina in Trapani. The exports of sulphur in 1871 were as follows:—

To France..	16,909	tons.
England	31,036	„
America	41,758	„
Other countries	81,533	„
	171,236	

The quantity taken by France and by England appears to be declining, whilst the demand in America and in other countries is increasing. The author calculates that in fifty to sixty years the Sicilian mines will be exhausted. The treatment of the ore is very primitive: it is a simple fusion, where the sulphur itself serves for fuel, and which is carried on almost in the open air without any regard to waste. Thus the ore which contains 15 to 40 per cent of sulphur yields only 10 to 25. Great damage is also done to agriculture, and to the health of the workmen. Various improved methods have been tried, but prove too costly, chiefly on account of the high price of fuel. In 1871 the price of a quintal of sulphur, delivered on board ship in a Sicilian port, was 12 francs, including the export duty of 1 franc. Before the expiration of two years, thanks to the railways, the price will be reduced to 10 frs. 50 cents, which, by suppressing the duty, might be lessened to 9 frs. 50 cent. Sicilian sulphur could thus be delivered at about 12 frs. at Marseille, and 12 to 13 frs. in the ports of England and the North Sea. The use of pyrites instead of sulphur represents a saving of 4 frs. per quintal at Marseille; 6 frs. in Belgium and Northern France; and 5 to 6 francs in England. Native sulphur, as compared with pyrites, offers certain practical advantages, which, according to Balard and Parodi, may be valued at 2·27 frs. per quintal. The economy of using pyrites is thus reduced per quintal to 1·73 frs. in Marseille, 3·73 frs. in Belgium, and 3·23 frs. in England. The author concludes that the manufacture of chemical products in Italy will always be restricted by the scarcity of fuel.

Discovery of Crystalline Digitaline.—C. Nativelle.

New Method of Preparing Salicylic Acid, and on some of its Properties.—H. Kolbe.—Neither of these papers are suitable for abstraction.

Observations on Bleaching Woollen Goods.—M. J. Persoz.—Reserved for insertion in full.

Steaming Process in Calico Printing.—A. Schultz. —The author describes the various arrangements for steaming printed pieces, and gives the preference to the French apparatus, *a poches tournantes*, an engraving of which is added. The English steam-chest he considers suitable for wood colours, "with which the English have inundated all parts of the world except France," but less adapted for alizarin and extract of madder styles. For the latter colours he recommends to begin steaming at a very low pressure, increasing it gradually every twenty minutes, up to a half atmosphere in two hours.

Action of Nitric Acid upon Paraffin.—A. Gabriel Pouchet.—This paper is noticed elsewhere in the Chemical News.

Determination of Gaseous Sulphurous Acid.—A. Gabriel Pouchet.—Useless without the accompanying diagram.

Use of Naphthalin in the Preparation of Colouring Matters.—Prof. M. Ballo.—The author mixes naphthylamin and bromide of naphthalin in equivalent amounts, and heats them to ebullition in an open vessel, when the mass takes a dark colour, and appears by transmitted light of a dull red. Prolonged heating in the water-bath gives the same result. After cooling the mass remains liquid. It is extracted with ether, when a dark powder remains, which dissolves in alcohol with a fine violet colour. This is the hydrobromate of a base precipitable from its alcoholic solutions in blue flocks on the addition of much water and a little ammonia. These flocks are filtered off, dissolved in alcohol, and mixed with sulphuric acid. On evaporation the sulphate remains, forming a thin layer of a cupreous metallic lustre. The yield is very small. The action of the air seems necessary for the production of the colour.

Bulletin de la Societe Chimique de Paris, tome xxii., Nos. 4 and 5, September 5, 1874.

New Isomer of Saccharose.—Arm. Gautier.—The author has obtained, by dehydrating dextro-glucose, a new compound having the composition $C_{12}H_{22}O_{11}$. It is anhydrous, and is formed by the union of two equivalents of glucose, with elimination of water. It is a colourless body, in taste and appearance resembling dextrin or gum, very soluble in water, very hygroscopic, and cannot be entirely freed from water unless heated for some hours in a current of dry carbonic acid gas. In contact with the yeast of beer it does not ferment.

Correspondence from St. Petersburg.—W. Louguinine.—Notices of papers read before the Russian Chemical Society, March 7.

Removal of Grease from Wool.—M. J. L. Larcade. —Wools in their natural state contain suint and grease, which can only be removed by alkaline lyes. On the other hand, in order to spin them they must be saturated with a certain quantity of oil, which forms with dust, &c., residues not easily utilised. If the wool is brought in contact with sulphate of lime all the fatty matter is absorbed; the fibres are rendered absolutely dry, and all the solid foreign bodies can be afterwards removed by beating. A cylinder, fitted with spikes, works inside a closed drum. At one of the ends of the drum is a self-acting feeder, which throws the wool or the rags upon the spikes of the cylinder. A sieve, moved by an excentric, constantly sifts anhydrous sulphate of lime into the interior of the drum. The spikes which divide the filaments facilitate the saturation. A beater, with a blowing apparatus, expels afterwards the sulphate of lime saturated with grease, along with all the foreign matters.

Application of Cerulignon on Tissues.—M. Marx.—This substance, the cedriret of Reichenbach, dissolves in sulphuric acid with an indigo blue, and in creosote with a reddish purple. Fisher, of Stuttgard, produces with it a bright orange upon wool and silk. The cerulignon paste is dissolved in alcohol, and re-precipitated with water. The precipitate is thickened with gum, and printed upon silk or wool. After drying and steaming the printed parts appear colourless, though before the steaming they were slightly coloured. After washing, and passing through perchloride of iron or chromate of potash, the printed portions rapidly take a fine orange.

Accidental Colouration of White Lead.—G. C. Wittstein.—The reddish colouration occasionally found in white lead has been ascribed by Baker to the presence of silver. MM. Bannow, Kraemer, and Lorscheid attribute it to minium. The author has met with a sample in which the reddish grey colouration was due to ferric oxide. This sample dissolved in acetic acid, leaving 2·25 per cent of an insoluble residue, containing silica, sulphate of lead, and ferric oxide.

Researches on Ultramarine.—M. B. Unger.—The author considers soda as forming an integral part of ultramarine. The amount of free sulphur he considers equal to one-sixth of the total sulphur.

Galvano-Plastic Coppering of Cast-Iron Rollers for Calico Printing.—G. Schæffer.—Many attempts have been made in this direction by Lokett (Lockett ?), L. Huguenin, and Schlumberger. One of the defects of the coppered rollers was that they were capable of losing their true form—an accident easily remedied upon a cylinder of copper, but not upon those of coppered iron. Th. Schlumberger cleanses the iron cylinders with a concentrated alkaline lye, washes well in water, and goes over the whole surface with the file. The surface is then very bright, and is not to be touched with the fingers or soiled with the breath. It is then plunged in an alkaline bath composed of—

Sulphate of copper	1 part.
Dissolved in water	12 parts.
Cyanide of potasium	3 parts.
Carbonate of soda	4 ,,
Sulphate of soda	2 ,,
Dissolved in water	16 ,,
Or, Ammonia	3 parts.
Acetate of copper	2 ,,
Dissolved in water	10 ,,
Cyanide of potassium	3 parts.
Carbonate of soda	4 ,,
Sulphate of soda	2 ,,
Dissolved in water	10 ,,

The cylinder is allowed to remain twenty-four hours in one of these baths, subject to the action of a battery of 4 or 6 pairs, till the surface is coated with a slender but adherent layer of copper. It is washed and cleansed with pumice-stone. If in this operation the iron should be laid bare in any part, the cylinder must be anew submitted to the alkaline bath. As soon as the coating of copper is uniform it is washed in acidulated water, and immersed in an acid bath of sulphate of copper. This bath is composed of solution of copper at 20° B., to which 1-300th of its volume of sulphuric acid is added to facilitate the solution of some metallic copper, which is also immersed in the bath for the purpose of maintaining the solution in a uniform state of concentration. Here the cylinder is left till the layer of copper has attained the desired thickness, a galvanic current being kept up by a battery of four pairs. If the temperature is between 15° and 18°, three to four weeks are required to produce a deposit of three-quarters of a millimetre in thickness. The cylinder is turned one quarter round daily to change the portion of its surface which faces the sheet of copper used as a positive electrode.

Formation of Molasses.—F. Anthon.—Certain authors classify the bodies which accompany sugar, whether organic or inorganic, into products determining the formation of molasses, products preventing it, and indifferent bodies. The author, having undertaken a series of experiments to verify this view, finds that one and the same body may, according to proportions, either favour crystallisation, hinder it, or remain indifferent. The classification above mentioned is, therefore, not well founded.

Reimann's Farber Zeitung, No. 38, 1874.

This number contains a continuation of the directions for dyeing felt hats; instructions for removing spots from garments to be re-dyed; a receipt for an aniline green on silks, the peculiarity of which is that the goods are grounded with aldehyd green, and afterwards topped with iodine green mixed with picric and acetic acids.

There is a notice that the manufacture of Croissant and Bretonnière's patent colours at Göttingen has been suppressed by the police authorities as a nuisance.

Receipts for Printing Woollens.—*Scarlet.*—

Starch	4½ lbs.
Cochineal liquor at 6° B.	18 litres.

Incorporate at a boil, and add—

Tin crystals	9 ozs.
Oxalic acid	1½ lbs.
Solution of tin crystals at 6° B.	2½ ,,
Fustic liquor at 15° B.	1½ ,,
Oil of turpentine	½ litre.

Black.—

Extract of indigo	½ lb.
Crystalline chloride of ammonium	¼ ,,
Calcined starch	16 lbs.
Extract of logwood at 7° B.	16 litres.

Boil, stir till nearly cold, and add—

Nitrate of iron at 55° B.	2 lbs.
Chloride of iron at 45° B.	1 lb.

Stir till cold, and add—

Oxalic acid	2 ozs.
Chromate of potash	4 ,,

The longer this colour is preserved the finer the black becomes.

Dark Brown.—

Starch	24 lbs.
Burnt starch	24 ,,
Extract of indigo	10 ,,
Crystalline chloride ammonium	2 ,,
Extract of orchil	208 litres.
Water	20 ,,

Boil, and add—

Alum	16 lbs.

Blond.—

Extract of indigo	1¾ ozs.
Alum	½ lb.
Oxalic acid	¼ ,,
Extraction of fustic	as required.
Extract of orchil	
Gum water	

Green.—

Extract of indigo	15 ozs.
Alum	5 lbs.
Oxalate of potash	25 ozs.
Yellow paste	18 lbs.
Gum water	as required.

Yellow Paste.—Precipitate the decoction of fustic with a little sulphuric acid and bichloride of tin; filter the whole, let the sediment drain on the filter, and use it whilst still moist.

Next follow receipts for dyeing ombrés and double ombrés; for printing calico with aniline colours; and for dyeing a fast black upon cotton-wool capable of bearing the stocks.

The chemical section of the Société Industrielle de Mulhouse has expressed an opinion that the colours of Croissant and Bretonnière furnish very fast, though not brilliant, shades both in dyeing and printing, and will be applicable in simple but very fast styles.

J. Casthélaz, of Manchester, prepares aniline brown and black by treating aniline and nitro-benzol with sulphuric acid in excess and bichromate of potash, with or without the application of heat. The soluble colouring matter, when extracted, yields upon wool a brown colour, which becomes black on passing it first through chromate of potash, and then through an alkaline bath.

MISCELLANEOUS.

Death of Dr. T. Anderson.—With regret we announce the death of Thomas Anderson, M.D., F.R.S.E., formerly Professor of Chemistry in the University of Glasgow. He died at Chiswick, on the 2nd inst.

Physical Society.—The first meeting of the Session 1874-5 will be held at three p.m. to-morrow, Saturday, November 7th, 1874, in the Physical Laboratory, Science Schools, South Kensington, when the following communications will be made to the Society:—"On Graphical Methods of Treating certain Elementary Electrical Problems," by Prof. G. C. Foster. "On an Instrument for Multiplying Small Motions," by Mr. G. F. Rodwell. "On Salt Solutions and Water of Crystallisation," by Prof. F. Guthrie.

NOTES AND QUERIES.

Petroleum Query.—Is there any substance known that will drown the odour of petroleum oil, or diminish the unpleasant smell of it?—W. Hughes.

Condensing Towers.—Some years ago I planned a system of condensing towers (for wet) and horizontal or any angle for gases, which I have never yet seen equalled for efficiency, assuming that the greatest amount of surface available in least possible space is efficiency. I showed it to Dr. Lünge, of Newcastle, and Mr. Reed, of Blaydon Co., and both said it was better, even for Mr. Deacon's process, than his marbles. My object in writing is to ask you what is the *most conclusive* experiment I could make, in a small way, to prove efficiency. To patent, is to publish *pro bono pub.* gratis; and to get a manufacturing chemist to try it is difficult, even if you could depend on him. I should like to put up some small arrangement in which I could show that I could condense at such and such a rate, from which larger apparatus could be illustrated. If you can suggest such an arrangement or experiment, I should be much obliged.—John Clipp.

TO CORRESPONDENTS.

G. Combe Stewart.—Your communication arrived too late for insertion in the present number.

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THE CHEMICAL NEWS.

Vol. XXX. No. 781.

PREPARATION OF SULPHOVINIC ACID AND ITS SALTS.

By T. L. PHIPSON, Ph.D.

The preparation of sulphovinic acid is by no means an easy operation, and, as certain compounds of this acid are now beginning to be used in medicine, perhaps the following observations may not be devoid of some practical interest.

When sulphuric acid and alcohol are mixed together without any special precautions, the temperature rises, and a certain quantity of sulphovinic acid is formed at once; but, as in the formation of this acid a certain proportion of water is set free, and prevents the continuation of the reaction, it is never completed, even after the mixture has been kept for some hours in a water-bath, and at a higher temperature decomposition at once ensues. It may, nevertheless, be quite possible to obtain a sulphovinic acid tolerably pure with alcohol and sulphuric acid alone (instead of the present tedious method based on the decomposition of the baryta salt), by keeping the mixture at 100° for two or three days and not acting upon too large a quantity. I intend to try this experiment shortly.

To obtain sulphovinate (ethyl-sulphate) of lime, it is best to mix equal volumes of concentrated sulphuric acid and alcohol; they may be mixed without any special precautions when small quantities only are used, and the uncovered vessel containing the mixture must be transferred to a water-bath and kept there eight or ten hours at least, during the whole of which time the temperature should be 100°, or nearly. The liquid will then have acquired a slight degree of fluorescence and a decided odour of ether (not an odour of sweet oil of wine), and should be only very slightly coloured. When cool, it is added, drop by drop, to about twenty times its volume of cold distilled water, carefully avoiding any rise of temperature, and keeping the liquid well stirred. This solution is saturated with pulverised chalk, added in small quantities at a time, until effervescence ceases. When a slight excess of chalk has been added, filter off the sulphate of lime, heat the filtrate in the water-bath with a little carbonate of lime for about half an hour, filter while warm, and evaporate at a heat not exceeding 100° till a permanent saline layer forms at the surface;* then place the capsule in a dry and moderately dry place. In about twenty-four hours the crystals are formed; the mother-water will give another crop when allowed to evaporate over sulphuric acid or chloride of calcium. If the chalk contains iron or manganese, their sulphovinates remain in the mother-water, and are perfectly separated by pressing the crystals.

Sulphovinate of lime crystallises rather slowly, even in very concentrated solutions; it forms large, brilliant plates, something like chlorate of potash; its composition is represented by $C_4H_5O,SO_3+CaOSO_3+2HO$; it is very soluble in water and in alcohol. The impure salt can easily be purified by re-crystallisation from alcohol.

Sulphovinate of baryta has a similar composition and similar properties; it can be obtained in the same manner. When the crystals are pure, they form very large, brilliant plates, oblique rectangular prisms, modified in certain angles. Both this salt and the lime-salt often present a peculiar pearly aspect, which I do not observe on small pure crystals; these are perfectly transparent, and I believe this pearly aspect to be mainly owing to minute quantities of carbonate or sulphate dispersed through the larger crystals.

The sulphovinate of soda could be obtained pure from either of these salts without difficulty, but, for the preparation of the pharmaceutical product on a large scale, it is more economical to make it directly. I hope to refer again to this compound.

London, November 9, 1874.

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* During this evaporation, a slight, but distinct, odour of butyric acid is perceptible.

ON THE DETERMINATION OF IRON IN CLAY-IRONSTONES CONTAINING PYRITES.

By W. F. K. STOCK, F.C.S, and W. EDWIN JACK.

The method usually adopted in assaying clay-ironstones is as follows:—1 grm. of the ore is treated with strong hydrochloric acid at nearly boiling-point for about twenty minutes. The solution is diluted with hot water to about 400 c.c., and, without being filtered, is brought to the boiling-point, reduced by a suitable reagent, and titrated by a standard solution of potassic bichromate.

As a rule, this process yields very satisfactory results; but, some years since, one of us, in making a cursory examination of a complete section of a well-known iron deposit in the Cleveland district, noticed the occurrence of a small band of ore some 4 to 6 inches in thickness, containing a considerable amount of organic matter, and also, as it afterwards proved, a large quantity of iron pyrites. In assaying a sample from this band by solution in hydrochloric acid, reduction with stannous chloride, and titration by potassic bichromate, it was found that, after the ferrous chloride had been completely oxidised by the potassic bichromate, a gradual reduction spontaneously occurred and several cubic centimetres of the oxidising solution were required before the potassic ferricyanide again indicated a total absence of ferrous salt.

We have lately submitted the ore in question to a careful examination, and we find that the reproduction of ferrous salt is owing, partly to the formation of ferrous sulphate, arising from the oxidation of the pyrites by atmospheric oxygen, and partly to the reduction of ferric chloride by sulphurous acid simultaneously generated, according, as we believe, to the following equations:—

$$FeS_2+O_6=FeSO_4+SO_2,$$

and—

$$Fe_2Cl_6+SO_2+2H_2O=2FeCl_2+H_2SO_4+2HCl.$$

In order to note the degree in which the pyrites interfered with the usual reaction, we made the following determinations:—

(1). The sulphur in the ore was carefully determined, when 16·8 per cent was obtained, which represents 31·5 per cent of ferric sulphide.

(2). One grm. of the ore was treated with hydrochloric acid, and assayed in the usual way, when 23 per cent of metallic iron was indicated. After allowing the solution to boil for a few minutes, it was found that a considerable reduction had occurred, which increased to such an extent that, in half an hour, it was necessary to add bichromate equal to 50 per cent of metallic iron before a negative reaction with potassic ferricyanide was obtained.

(3). One grm. of ore was treated with hydrochloric acid, the solution filtered and titrated as before, the result being an indication of 18·75 per cent of metallic iron. No after reduction was observed.

(4). One grm. of ore was first calcined, then treated with hydrochloric acid, and the insoluble portion, which still contained a notable quantity of iron, filtered off and fused with sodic carbonate. The iron obtained in this experiment, which, of course, is the true amount, was 30·1 per cent. A check assay was made, when 30 per cent of iron was indicated.

As we have noticed similar discrepancies occurring in the assay of ores from different localities, we recommend that, in all cases where much organic matter is present, the ore be first calcined, then fused with alkaline carbonate, dissolved in hydrochloric acid, and titrated as usual; as in ores of this class organic matter and pyrites are naturally associated.

ZINC BLENDE FROM AN ANTIMONY MINE.

By ROBERT FRAZER SMITH, F.C.S.

As far as I have heard, there are only two antimony mines in Great Britain, one at Glendinning, Dumfriesshire, and the other at New Cumnock, Ayrshire. The first was pretty extensively worked for some time, but is now at present neglected; the second was opened up a generation ago, and again recently, with what success remains to be seen. It has appeared to me very strange that, especially at the Cumnock mine, not a specimen can be picked up of any sulphide but antimony. At Leadhills, copper, zinc, antimony, and other sulphides occur in abundance. At the famous Australian antimony mine, no distinct specimens of blendes can be procured.

But, some time ago, specimens of antimony ore were sent to me from Glendinning which had peculiar black crystals intermixed with the steel-coloured antimony ones. Happening recently to be at leisure, I found, on analysis, they contained as follows:—

Zinc	62·84
Antimony	1·12
Iron	0·49
*Calcic carbonate	1·95
Sulphur	32·50
Insoluble and loss	1·10
	100·00

* The matrix was calc spar.

This is the first instance I have heard of zinc occurring in the same vein with antimony, where the latter formed the staple of the vein.

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph.D.,

(Continued from page 214.)

I have tabulated a number of experiments with genuine commercial samples of various makers from different parts of the country; they are the result of 400 alcohol tests and of 250 bisulphide of carbon tests, and the deductions drawn from these figures strikingly show the difference of the two tests, and also the low quality of the product sold at present:—

Alcohol Test of 400 Commercial Samples.

Melting-Points. Deg. Cent.	Below 10 per cent.	10 to 20 per cent.	20 to 30 per cent.	30 to 40 per cent.	40 to 50 per cent.	50 to 60 per cent.	60 to 70 per cent.	70 to 80 per cent.	80 to 90 per cent.
Below 160	—	1	—	1	—	1	—	—	—
160—170	—	—	1	—	1	1	—	—	—
170—180	—	2	4	3	3	—	—	—	—
180—185	—	1	11	16	3	2	1	—	—
185—190	—	7	21	30	20	18	5	—	—
190—195	—	24	35	48	51	21	13	2	—
195—200	2	9	6	10	5	6	5	2	1
Above 200	—	1	1	1	—	1	1	2	—
Total	2	45	79	109	83	50	25	6	1

Bisulphide of Carbon Test of 250 Commercial Samples.

Melting-Points. Deg. Cent.	Below 10 per cent.	10 to 20 per cent.	20 to 30 per cent.	30 to 40 per cent.	40 to 50 per cent.	50 to 60 per cent.	60 to 70 per cent.	70 to 80 per cent.
195—200	—	2	1	—	—	2	—	—
200—205	4	13	16	12	9	4	—	—
205—210	5	24	47	35	6	—	4	—
210—215	2	11	32	8	4	—	—	—
215—218	5	—	—	—	2	—	—	2
Total	16	50	96	55	21	6	4	2

In summarising these figures, we find with the alcohol test out of 400 samples:—

47,	or about	12	per cent,	contain	less than 20	per cent	insoluble.
79,	"	20	"	"	from 20 to 30	"	"
109,	"	27	"	"	" 30 " 40	"	"
83,	"	21	"	"	" 40 " 50	"	"
50,	"	12½	"	"	" 50 " 60	"	"
32,	"	8	"	"	above 60	"	"

Again, as to the melting-point we find:—

153,	or about	38	per cent,	melt	below 190	deg. C.
194,	"	48	"	"	between 190 to 195	deg. C.
46,	"	12	"	"	" 195 " 200	"
7,	"	2	"	"	above 200	"

Looking at the bisulphide of carbon test, we find equally satisfactory results, viz., out of 250 samples—

16,	or about	6	per cent,	contain	less than 10	per cent	insoluble.
50,	"	20	"	"	from 10 to 20	"	"
96,	"	38	"	"	" 20 " 30	"	"
55,	"	22	"	"	" 30 " 40	"	"
21,	"	8	"	"	" 40 " 50	"	"
12,	"	5	"	"	above 50	"	"

Again, as to the melting-point we find:—

5,	or about	2	per cent,	melt	between	195 to 200	deg. C.
58,	"	23	"	"	"	200 " 205	"
121,	"	48	"	"	"	204 " 210	"
57,	"	23	"	"	"	210 " 215	"
9,	"	4	"	"	"	215 " 218	"

I am indebted for these figures to my friend Mr. Manning, in whose laboratory these analyses have all been made in the course of last year; they fairly represent the quality of anthracen met with in the market at that time, and I do not think any sensible improvement has taken place since. Surely the manufacturer must soon find it to his own advantage to supply a higher class article.

With the alcohol test we have 80 per cent containing less than 50 of insoluble, but only 2 per cent of more than 70 per cent of insoluble, which is the lowest quality the alizarine maker could use. Taking the melting-point, we have 38 per cent below 190° C., the lowest melting-point at which the article is at all saleable, and only 2 per cent above 200° C., which is not even the true melting-point.

With the bisulphide of carbon test we have 94 per cent, with less than 50 per cent of insoluble, and only 5 per cent above that, while the melting-point in all samples is much better, only 2 per cent below 200° C., and 94 per cent between 200° and 215° C.

To show the comparative value of the two tests, it was necessary to make a series of experiments with both alcohol and bisulphide, and the following list gives a few of such experiments. I have purposely selected a great variety, from the lowest to the highest quality, which will bring out several points most prominently. I have given the results in round numbers, omitting the decimals, both in percentage and temperatures. (See next column).

These thirty experiments represent samples varying with the alcohol test from 20 to over 70 per cent, with a melting-point running from 154° to 211° C., while the bisulphide of carbon test varies from 5 to over 70 per cent, with a melting-point of from 201° to 218° C.

The relative proportion between the two tests fluctuates with bewildering variety. With the low percentage the

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* Read before the Society of Arts, Chemical Section.

Comparative Results of Alcohol and Bisulphide of Carbon Tests.

Alcohol.		Bisulphide of Carbon.	
Per cent.	Melting-point. Degs. C.	Per cent.	Melting-point. Degs. C.
20	154	5	212
20	184	5	204
22	165	5	218
25	177	13	209
27	187	18	207
27	183	15	208
28	181	13	209
30	184	10	208
32	184	21	205
35	183	21	209
36	181	18	202
38	180	22	203
41	184	27	208
42	188	28	211
43	191	31	204
44	189	32	207
46	192	31	209
47	188	32	207
50	192	36	207
51	198	42	212
33	194	36	209
54	157	10	204
56	185	40	201
57	189	43	205
58	183	41	201
59	190	42	203
61	198	50	211
64	200	61	208
69	201	64	208
72·5	211	74	213

difference is as much as 4 to 1, with a vast difference in the melting-point; but the higher the percentage the more uniform it becomes; nay, with the last sample the alcohol is actually lower than the bisulphide with nearly the same melting-point, namely 72·50 per cent 211° C., against 74 per cent 213° C.

Looking at the melting-point only in all these tables, the bisulphide of carbon series are the most reliable as approaching the quality of pure anthracen; the last table of alcohol test gives only one-third melting above 190° C., whilst the previous table gives about two-thirds, the rest being only indifferent.

If we want to compare the two tests, we can take only those alcohol samples which melt at or above 190° C. We then find the average proportion to be about 3 to 2, but as we know that the one product is much purer than the other, it must be clearly understood that it is so much more valuable, and no attempt should be made to simply substitute the one test for the other. However, under all circumstances, it will be desirable to improve the quality generally and to increase the percentage, especially by separating the oil as much as possible. But as long as this is not done, I would propose to wash the samples to be tested with light petroleum spirit, and to press and to dry them before using either alcohol or bisulphide; thus a more correct result will be obtained, and in case this should be adopted, more uniformity in the analysis would be insured. But, after all, these tests only give approximate results, and the want of a truly scientific treatment has long been felt. Now in producing alizarine from anthracen, the first step is to convert it into anthrachinon, and this reaction appears to be capable of adoption for analytical purposes.

Mr. Luck, a chemist at Meister Lucius and Co's., published, some months ago, in the *Berichte der Deutschen Chemischen Gessellschoft*, the following details of an—

Anthrachinon Test.

Heat in a flask 1 gramme of anthracen together with 45 c.c. glacial acetic acid till it gently boils; add gradually, and at intervals of 5 to 10 minutes, a solution of 10 grammes of chromic acid in 5 c.c. of glacial acetic acid and 5 c.c. of water. To prevent any loss of acetic acid during boiling, the flask is mounted with a condenser, which allows the acid constantly to flow back. About two hours gentle boiling in most cases completes the decomposition, after which allow to cool, add 150 c.c. of water, and let stand for a couple of hours. Light yellow needles of anthrachinon separate from the green liquid. Bring the whole on a filter, wash the crystalline residue first with water, then with a very dilute, hot solution of potash, until the liquid runs off perfectly colourless; and, lastly, again with water, to remove traces of alkali. Now dry the filter in a water-bath, and when perfectly dry detach the anthrachinon with a spatula, and weigh. This last direction is given in preference to weighing the residue and filter, because it has been found that the dilute chromic and acetic acid dissolve part of the filter, the original weight of which would thereby be altered.

Before calculating the anthracen from the anthrachinon obtained, a correction must be made; it has been found that 50 c.c. of acetic acid and 150 c.c. of water, as used above, dissolve 0·010 gramme of anthrachinon, which must be added to the weight actually found.

If the anthracen contains sand, or other impurities insoluble in acetic acid, a previous filtration through a small filter becomes necessary; very oily samples have to be pressed first between blotting-paper. Now, this test is based upon the argument that chemically pure anthracen yields the theoretical quantity of chemically pure anthrachinon, and that the other hydrocarbons are either destroyed by oxidation, or are converted into compounds readily soluble in diluted alkali.

I think as far as the experiment with pure anthracen goes, the result may be satisfactory, and after having ascertained that the quantity of acid and water used dissolved anthrachinon which corresponds exactly to one per cent of the sample, the above correction may possibly be admitted, although it is rather a novel addition to analytical chemistry; but as soon as we have to do with a mixture, the conditions are changed, and such corrections would make the analysis worthless. Another drawback is the necessity of detaching the anthrachinon from the filter, which is simply impossible without scraping off some paper and losing some crystals.

But a still more serious objection is the fact that some of the other hydrocarbons are acted upon in precisely the same manner as anthracen, and their products are as little soluble in dilute alkali as anthrachinon itself.

Phenanthren dissolved in acetic acid is very slowly oxidised by chromic acid, so that after six or eight hours boiling much is left unaltered; the phenanthrachinon forms needles of an orange colour, which melt at 205° C., and may thereby be distinguished from anthrachinon, which melts at 273° C., but phenanthrachinon is further decomposed in biphenic acid, $C_{14}H_{10}O_4$; but this is a later reaction.

Chrysene treated in a similar manner yields also a chinon, in orange-yellow needles, insoluble in alkali.

Thus we see two at least of the impurities, and perhaps the two most important ones, form similar compounds to the one which should stand out alone in the whole series; the attempted separation is not complete, and the test is highly unsatisfactory. On the one hand the results are too low, and on the other hand they may be too high.

I had hoped to find in picric acid a means of separating the different hydrocarbons, but, as I have pointed out before, although the whole series forms picrates, the compounds are so little stable, and we cannot separate them with sufficient accuracy, that an analytical method is not likely to result from the use of this acid.

At present, then, we must confess the want of an absolutely true quantitative laboratory test, and I am not very sanguine of complete success in this direction. I may compare the difficulties we have to encounter with those met with in the determination of the alkaloids in cinchona bark; here also we have a whole series of compounds, extremely similar to each other in their chemical and physical behaviour; here also we have one member of the series, the quinine, prominently standing out; and although the subject has been studied for many years, and although several methods have been proposed and are followed out, we must confess none of these methods give entirely satisfactory and reliable results.

But if chemical science is at fault here, let the manufacturer make use of it, when it can assist him, in the improvement of his crude material; let him produce an article of high percentage, and he will thereby best assist himself in removing the difficulties in the valuation of his product.

(To be continued).

LECTURES ON CRYSTALLOGRAPHY AT THE CHEMICAL SOCIETY, BURLINGTON HOUSE.

Professor Maskelyne has offered to give a short course of lectures on crystallography to those members of the Chemical Society who may be desirous of studying this subject. It is proposed, if a sufficient number of members intimate their intention of attending, that the lectures be delivered on Mondays and and Fridays, at 8.30 P.M., during the months of November, December, and January, commencing on the 23rd inst. Professor Maskelyne hopes it will be understood that gentlemen attending these lectures will be prepared to devote some of their leisure to working at the subject, in the manner to be indicated by the lecturer. Crystallography cannot be studied without geometrical reasoning, but it will be Mr. Maskelyne's endeavour to treat his subject with as small an amount of mathematical detail as is consistent with its due development. The lectures will be open to any one introduced by a Fellow of the Chemical Society. It is particularly requested that members intending to attend these lectures will communicate their intention, previously to the 20th inst., to Dr. Russell, Chemical Laboratory, St. Bartholomew's Hospital, E.C.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 4th, 1874.

Professor **Odling**, F.R.S., President, in the Chair.

After the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. C. Armbruster, G. Christopher, W. H. Carter, J. H. Davies, and W. Pierce, Jun., were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. E. Woodhead, T. Harrison, A. L. Sparkes, D. Kingsford, W. H. Griffith, E. W. Parnell, R. Hedderwick Ker, W. R. Hodgkinson, G. W. Slatter, W. Hargreaves, A. Deck, J. E. Morris, Roland H. Ridout, W. Payne, W. Griffin, and D. C. Mackenzie. For the third time—Messrs. Edwin Rider Cook, John Cox, and Henry John Cook, who were balloted for and duly elected.

The first paper, "*On Methyl-Hexyl Carbinol,*" by C. Schorlemmer, F.R.S., was then read by the Secretary. From previous experiments on the methyl-hexyl carbinol, obtained by distilling castor-oil soap with soda, the author expected that the alcohol would yield normal caproic acid on oxidation. The purified alcohol boiled at 177° to 178° C., and the caproic acid prepared from it boiled at 204° to 206°. The calcium and barium salts corresponded exactly in composition and properties with those described by Lieben and Rossi. The octane, however, obtained from methyl-hexyl carbinol does not yield a trace of acetic acid on oxidation, this differing from the other normal paraffins in this respect.

The President said the thanks of the Society were due to Dr. Schorlemmer for this interesting paper in relation to the subject which he had done so much to elucidate.

Mr. Neison said the results of Dr. Schorlemmer agreed with those he had obtained, except in one point. He had found it impossible to purify the alcohol completely by fractional distillation and treatment with sodium bisulphite. It then boiled at 177° to 178°, but always contained traces of the ketone, which could be separated. on converting the alcohol into the octylene boiling at 125° C., by treatment with zincic chloride. By repeated distillation from caustic soda, however, the alcohol could be obtained in a pure state, and it then boiled at 182° to 183° C.

Dr. Armstrong thought the chief interest of the paper was that the alcohol was proved to yield normal caproic acid, as it well illustrated the great advantage of a comparison of the physical properties in ascertaining the nature of such compounds.

The next paper, "*On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids*" (Part 1), was read by the author, Dr. C. R. A. Wright. By long digestion of dry codeine with glacial acetic acid or with acetic anhydride, it is converted into the crystalline diacetyl-codeine, $C_{36}H_{40}(C_2H_3O)_2N_2O_6$, which is soluble in benzine, chloroform, and boiling-water. The base yields a crystalline hydrochloride. The action of glacial acetic acid on morphine gives rise to the formation of α-diacetyl-morphine, $C_{34}H_{36}(C_2H_3O)_2N_2O_6$, which can, with difficulty, be obtained in the crystalline state; the hydrochloride, however, crystallises readily. With excess of acetic anhydride, morphine forms tetracetyl-morphine, which crystallises readily, and is soluble in ether, alcohol, and benzine. Its hydrochloride is excessively soluble in water. At the same time as the tetracetyl compound, α-diacetyl-morphine is produced. When the acetic anhydride is not in excess, three distinct diacetyl-morphines appear to be produced, the β compound being the principal product. With a small quantity of acetic anhydride, monacetyl-morphine is obtained. All these compounds are more or less readily decomposed by the action of boiling-water into the original base and acetic acid. The physiological action of these new bases has been examined by Dr. Pierce, who finds that it is nearly the same as that of deoxy-morphine and deoxy-codeine.

Dr. Odling having thanked the author in the name of the Society, a paper "*On the Action of Bromine in the Presence of Water on Bromo-Pyrogallol and on Bromo-Pyrocatechin,*" by Dr. J. Stenhouse, F.R.S., was read. The author finds that, although dry tribromo-pyrogallol is not acted on by dry bromine, yet the mixture, when dissolved in water and gently heated, deposits a new compound in brilliant yellow scales, having the formula $C_{18}H_4Br_{14}O_5$. *Xanthogallol* is insoluble in water, but readily soluble in benzine and in ether. Its solution in the latter, when agitated with a solution of sodium carbonate, is decomposed, with formation of the sodium compound of a new substance which separates in pale yellow scales. These, when decomposed with dilute sulphuric acid, yield the new substance in slender colourless needles having the composition $C_{18}H_7Br_{11}O_9$. It is readily soluble in ether and benzine. Bromo-pyrocatechin, when treated with bromine and water, gives rise to *erythro-pyrocatechin*, $C_{18}H_2Br_{10}O$, a compound crystallising in scales of a magnificent dark crimson colour.

The President, in thanking the author, said that the formation of these condensed products was one of great interest; and, since there was not enough hydrogen in the compound to form hydroxyl with all the oxygen, it was a question how far the latter might be present in the quinone form.

Professor A. H. Church then read a paper "*On the Action of Baryta on Oil of Cloves.*" The author prepared the pure eugenol from English oil of cloves, and found that the terpene accompanying it boiled at 253·9° C. (cor.). After having been treated with sodium, an oily substance of high boiling-point, and possessing a strong creosotic odour, was also observed. The pure eugenol, when mixed with basic oxide and powdered zinc, and destructively distilled, yields from 10 to 15 per cent of an oil which, after purification, boiled at 263·5° C. (cor.). It has the composition expressed by the formula $C_{11}H_{14}O_2$, or that of methyl-eugenol. This compound, however, as obtained by the action of sodium-eugenol on methyl-iodide, boils at 237° C., so that the new compound would appear to be isomeric with methyl-eugenol. By oxidation, it yields dimethoxybenzoic acid, $C_9H_{10}O_4$, melting at 179·5° C.

Dr. ODLING said the Society was much indebted to Professor Church. The formation of methyl-eugenol in this way was of considerable theoretical interest.

"*Observations on the Use of Permanganate of Potash in Volumetric Analysis, and on the Estimation of Iron in Iron Ores*," by E. A. PARNELL, was then read by the Secretary. The author draws attention to the fact that, in determinations of iron by potassium permanganate, when the former is in the state of ferrous chloride, the colour of the ferric chloride produced interferes considerably with the determination of the exact point of peroxidation. By employing artificial light, however, this difficulty may, in a great measure, be obviated, and the method possesses the great advantage over that with potassium dichromate, that zinc may be used as the reducing agent instead of sulphurous acid. The author prefers arsenious acid for standardising the permanganate solution, and gives minute details of the best method of effecting this.

The PRESIDENT thanked the author for his paper, which contained so many practical hints.

The last paper was entitled "*Further Researches on Bilirubin and its Compounds*," by Dr. J. L. W. THUDICHUM. The author finds that bilirubin, $C_9H_9NO_2$, absorbs bromine vapour, and acquires a violet colour and golden lustre. The product appears to consist of dibromo-bilirubin, $C_9H_7Br_2NO_2$. It is soluble in alcohol, with an intense violet colour. With chlorine, a tetrachloro-bilirubin, $C_9H_5Cl_4NO_2$, appears to be produced, of a greenish yellow colour. Bilirubin absorbs nitrous acid, but no definite compound could be obtained. This paper also contains experiments on the alleged transformation of bilirubin into the colouring matter of urine.

The thanks of the Society having been given to the author, the meeting was adjourned until Thursday, November 19th, when the following papers will be read:—

(1). "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids" (Part II.), by G. H. Beckets and C. R. A. Wright, D.Sc. (2). "On the General Equations of Chemical Reactions," by W. K. Clifford, F.R.S. (3). "On Propionic Coumarin and some of its Derivatives," by W. H. Perkin, F.R.S.

The PRESIDENT announced that Professor Maskelyne had offered to give a short course of lectures "On Crystallography" to those members of the Chemical Society and their friends who may be desirous of studying this subject. If a sufficient number of members intimate their intention of attending these lectures to Dr. Russell, F.R.S., of St. Bartholomew's Hospital, they will be delivered on Monday and Friday evenings at Burlington House, at 8.30, during the months of November, December, and January, commencing on the 23rd inst.

CORRESPONDENCE.

THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—I beg to acknowledge how much the contents of your issue of the 9th of October interested me. One article especially claimed my attention, that by Mr. R. Frazer Smith, F.C.S., "On the Presence of Ferrous Sulphide in Bone-Char."

The chemistry of this substance is very important, and it must not be subject of wonderment that sugar refiners have devoted much attention to it, or that chemical knowledge should so frequently be sought after. They properly conclude that only the experienced chemist can be successful in its manipulation; and so thoroughly are they impressed with the advantages to be derived from *accurate* analysis of their sugars, chars, &c., that they invariably try to procure them. Some of the more indifferent sugar refiners neglect such assistance until landed in some difficulty, but, all things being equal as regards buying and selling, they cannot be said to hold that position of advantage which their more fortunate rival possesses. The correct chemical analysis of bone-char is, perhaps, one of the most difficult things in analytical chemistry; the experiments require particular caution to guard against error, and, above all, the process is highly facilitated by a close technical knowledge of the different processes involved in the sugar manufacture. Without such supplementary knowledge, I am inclined to think that the chemist is hardly in a position to construe his results in a manner useful to sugar refiners.

Considering these observations, and the manner in which they are made, I think I may fairly conclude that your correspondent's experience must have been derived from samples of bone-char so unlike those usually known to sugar refiners, as to render the information which he has given in the article referred to of very little avail to gentlemen like Mr. Speir and myself possessing an enlarged experience in the sugar refiners' art. It is very kind of him to improve a few chemists in their studies into the chemistry of this substance, and the shade of dogmatism which he throws over his communication I will allow him on that basis.

I desire to deal with a few of Mr. Smith's statements, *none* of which are new to me.

(1). Mr. R. Frazer Smith, F.C.S., at the very first sentence of his communication, commits himself when he asserts that "*all* chemists usually state the total sulphur in char as calcic sulph*ate*." In my humble opinion, this is saying too much. How can he take it upon him to tell your readers, through the medium of your columns, what all chemists do when they have occasion to analyse bone-char?

(2). Mr. R. Frazer Smith, F.C.S., claims the honour of discovering a ferrous sulphide in bone-char. Such are his statements, and he has advanced the "Yes" to them as positively as one can do. I think I possess sufficient facts and material to advance the "No" to them all.

It is asserted that "all chemists usually state the total sulphur in char as calcic sulph*ate*," &c. Mr. Smith will pardon me for saying that this very first statement of his in his communication does not embrace a fact. Let him ask Dr. Wallace, of Glasgow, and Mr. Speir, of the Dellingburn Refinery, if ever they overlook the presence of sulphides in bone-char, even when the sample is from an old working stock? And then let him consult me, and I will tell him that, out of many samples of bone-char which I have had occasion to analyse, I never once remember having overlooked the presence of these sulphides.

Why, Sir, this is a statement which I hold there is no justification for. Is your correspondent aware that our position, in overlooking the presence of these sulphides, would be at stake were we to do so? No, the fact is, Mr. Smith does not know the abilities of some of the most intelligent chemists connected with the Clyde sugar works. Indeed, the importance of the work which is usually entrusted to me, and the moral obligations which I am under to my employer to return accurate analyses of the many samples of bone-char submitted to me, will on no account cause me to overlook their presence. And I am glad to state that I do know it to be a fact that Dr. Wallace, of Glasgow, seldom fails notice the presence of these sulphides, simply for the same reasons which I havespecified; but—

"Facts are chiels that'll no ding."

and I think I have advanced sufficient facts to prove that "all chemists *do not* usually state the total sulphur in char as calcic sulph*ate*," even when the sample is from an old working stock.

Sir, Mr. Smith's paper contains nothing original to me. I considered nearly three years ago, when studying the chemistry of sugar in the laboratory of Messrs. Wallace, Tatlock, and Clark, at Glasgow, that I had *proved* (not supposed), without a doubt, that a ferrous sulphide did exist to a small extent in some particular samples of bone-char, the very thing which your correspondent now attempts to communicate to your columns as a piece of original research. I think that, after Mr. Speir has confirmed *my* discovery by his investigations, conducted some two years ago, it must be patent to most readers of the Chemical News that Mr. Smith is far behind in the march of original research into the chemistry of animal charcoal, particularly when he is *only now* observing facts discovered by Mr. Speir and myself *long ago*.

Mr. Speir is quite correct; the presence of ferrous sulphide is a fact well-known to most of the experienced chemists connected with the Clyde sugar works; and, further, I do know myself of *three* distinct individuals who were aware of its presence at least two years ago.

There are a few points connected with Mr. Smith's annexed analysis which I refrain from touching upon.—I am, &c.,

J. Combe Stewart, F.C.S.

Cappielow Sugar Refinery, Cartsdyke, by Greenock,
November 6, 1874.

THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

Sir,—On page 217 of the Chemical News I observe a letter from Mr. Smith, in reply to my former letter. In it he asserts that the whole of the experiments contained in his papers were his own. This I must most emphatically deny. Experiments 1 and 2 of his paper (the only ones which in my opinion go to prove the presence of ferrous sulphide in char) were carried out by Mr. Smith and myself on his coming into the employment of Messrs. Blair, Reid, and Steele. At that time Mr. Robert Frazer Smith was totally ignorant of animal charcoal, or its nature, and had not even made an analysis of it. The experiments referred to were carried out by him and me during the very first days in which he was in Blair, Reid, and Steele's laboratory, and before even an analysis of char had been made by him. The laboratory journal of Blair, Reid, and Steele is proof of this fact. I ask if any sane man could assert that Mr. Smith, knowing previously nothing whatever of charcoal, was likely to originate experiments to prove the presence of ferrous sulphide before he had made even an analysis of the substance under consideration. Even supposing that all the experiments had been originated by him, it would, under the circumstances, have been extremely uncourteous to have acted as he did; as it is, it is something more.

I annex a copy of a letter to me from Dr. Wallace, with an extract from a letter from him to Blair, Reid, and Steele (Mr. Smith's employers), of which Mr. Smith was well aware, but, through some defect in his memory, no doubt omitted to mention.—I am, &c.,

R. Speir.

Greenock, Nov. 10, 1874.

(Copy)

Chemical Laboratory, 138, Bath Street,
Glasgow, 27th Oct., 1874.

Mr. Robert Speir,—My dear Sir,—The letter you refer to is addressed to Messrs. Blair, Reid, and Steele, and dated 23rd March, 1874. It treats of various matters, amongst others of the FeS in charcoal. I give an extract below. I was under the impression that it was you who suggested the presence of FeS in charcoal—but no matter, so far as I am concerned, Mr. Smith is welcome to any credit he may think he has by his paper.—Yours faithfully,

Wm. Wallace.

Extract from letter to Blair, Reid, and Steele referred to:—

"The incrustation of metallic-looking substance in the interior of the pipe contains—

Sulphur	35·95
Iron	58·80
Other things, not estimated ..	5·25
	100·00

"It consists, therefore, essentially, of protosulphide of iron, and dissolves very freely in acids, with formation of sulphuretted hydrogen. In analysis of charcoal it is the invariable custom to state the iron in the condition of oxide, but I have long been of opinion that it exists wholly, or in part, as sulphide, and the occurrence of this incrustation, which I have never observed before, serves to confirm this opinion. It would be interesting to ascertain at what part of the pipes this sulphide of iron is formed. If, as I believe, it is a direct result of overheating the charcoal, it will be found only at that portion of the pipe where the flame strikes, and chiefly in the pipes of the front row."

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—As a curiosity in criticism, whether from a literary, æsthetic, or scientific point of view, the communication in the Chemical News, No. 775, p. 164, signed T. A. R., is possibly unique. Since one part is at any rate intelligible, and since a mineral of my describing and naming is included in the dead log of disgusting acquaintances, whose sudden death you are asked kindly to assist at, while inviting your friends to the battue of long enough unhung useless dogs, I beg to inform the writer, who only cares to know whether "the things so named exist at all, or, if so, what they are now called," that the "Cyanolite of *How*," as I described it, exists in the remains of the original specimen mostly in my possession, and that it has, so far as I know, no other name. I may add, though T. A. R. does not want the information, that I have never revisited the locality where I got it, and that I do not know whether any other mineralogist has procured such specimens as I gave an account of in the *Edinburgh New Philosophical Journal*, 1859.

There are doubtless a good many more minerals than those named by T. A. R. not kept in stock by mineral dealers, and I dare say some of them are even not to be found in the British Museum.—I am, &c.,

Henry How.

King's College, Windsor, N.S.
Nov. 2, 1874.

ARSENIC FLUORIDE.

To the Editor of the Chemical News.

Sir,—Having observed in your valuable journal (Chemical News, vol. xxx., p. 169) an article by R. W. Emerson Macivor, on "Arsenic Fluoride, I should feel greatly obliged if you can find space for the following remarks on the same subject:—If Mr. Macivor will look up the "Handwörderbuch der reinen und angewandten Chemie," vol. ii., p. 244, edition for 1858, he will find the arsenic fluoride described much more fully than in his article, all the properties ascribed to it by Mr. Macivor being given. I merely mention this fact, as Mr. Macivor seems to imagine he has conferred some benefit to the Science of Chemistry by re-describing a well-known compound without explaining anything new about it.—I am, &c.,

M. N. C.

Tübingen, November 2, 1874.

THE ANALYSIS OF PHOSPHATES, &c.

To the Editor of the Chemical News.

Sir,—It will probably interest your correspondent of the 30th ult., and other readers of the Chemical News, to learn that at the recent meeting of the British Association, at Belfast, a Committee—consisting of Messrs. E. C. Stanford, E. Dewar, A. Fletcher, and myself as Secretary (with power to add to our number)—was appointed to report on the methods employed in the analysis of phosphates and of potash-salts, and on the best mode of stating the results.

With regard to phosphates, the intention of the Committee is to ascertain, by inquiry, what methods are in use, and to learn the opinions of the chemists using them as to their special advantages and limits of error, and then either to apply for a further grant (the present one being almost nominal), with the view of rigidly testing the accuracy of one or two processes, or at once to recommend one for general adoption.

It seems probable that an accurate and practical process, if officially recommended by a Committee of the British Association, would meet with a very general adoption among chemists, and that a "B.A. method" would be welcomed by both buyers and sellers as a perfectly neutral standard of reference, while chemists' results would exhibit less variation than is unfortunately the case at present, and the crying scandal of the existence of buyers' and sellers' analysts would die a natural death.

The Committee will very shortly proceed to the collection of data, and will be pleased to receive suggestions from all interested in the objects aimed at. Any communications addressed to me as Secretary will of course receive the attention of the Committee.—I am, &c.,

Alfred H. Allen.

1, Surrey Street, Sheffield.

BUTTER: ITS ANALYSIS AND ADULTERATIONS.

To the Editor of the Chemical News.

Sir,—In your journal (Chemical News, vol. xxx., p. 174) you had the kindness to publish a short review of our little book on "Butter." As this review contains several inaccuracies, which greatly tend to diminish the value of our method for detecting and estimating foreign fats in butter, we trust that you will permit us to correct them.

Our method does not consist in the distillation of the butter soap with dilute sulphuric acid, and the estimation of the acidity of the distillate, but in the estimation of the *insoluble fatty acids*. The objection you raise against the distillation—namely, that the acidity of the distillate might not only be due to butyric acid, but also to acids produced by the decomposition of the glycerin and the sulphuric acid—we have foreseen, and therefore avoided it. Granted that such decomposition might take place, it is of no practical importance whatever as regards our method. We have found, by many experiments, that the amount of *insoluble* fatty acids in animal fats (except butter) corresponds very closely with the theoretical quantity,—namely, 95·5 per cent,—while butter yields never more than 86·2 per cent. The difference between the quantity of fatty acids found in butter and that found in other fats, is, on an average, 9·65 per cent, and we conclude that it must be due to soluble acids. But supposing this inference to be erroneous, the facts remain the same, and are equally available for the estimation of foreign fats when mixed with butter. Mr. Wanklyn suggests that butter might possibly contain mono- or di-olein, &c., which would equally well explain the difference. We must, however, emphatically contradict his statement, that it is not possible to obtain by distillation more than 0·1 per cent of volatile acids from butter. The smell alone can convince him of the contrary: 3 grms. of butter, saponified, and decomposed with sulphuric acid, emit such a powerful smell that it is hardly possible to remain in the room. According to him this smell is due to 3 milligrms. of volatile acids.—We are, &c.,

Arthur Angell, F.R.M.S.
Otto Hehner.

Southampton, October 12, 1874.

[Nothing could be further from our intentions than to give any annoyance to the authors, or to depreciate the legitimate value of their method. They certainly, however, fail to point out the "several inaccuracies" of which they accuse us. In their book they state that they had recourse to the indirect estimation of the volatile acids because they found it "impossible to obtain the *whole amount present* by distillation." In the above letter, on the contrary, they tell us that they foresaw our objection, and therefore avoided the direct process. Now, as our "objection" was a request for proof as to the nature of the distillate,—in default of which the volatile acids may possibly be *less* than the amount thus formed,—the above two statements seem to us contradictory. Not having quoted Mr. Wanklyn in our notice of the work we feel disposed to question the relevancy of introducing his name on this occasion. We do not undervalue the nose as an instrument of preliminary qualitative research, but somewhat distrust its quantitative indications.—Ed. *C. N.*]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 13, September 28, 1874.

This number is entirely occupied with the discourses delivered in honour of Elie de Beaumont, late one of the perpetual secretaries.

No. 15, October 12, 1874.

Critical Observations on the Use of the Tincture or the Powder of Guaiacum to Ascertain the Purity of Kirschenwasser.—M. Boussingault.—The blue colouration, on the addition of guaiacum, relied on as a mark of purity, is common to every alcoholic liquor containing copper.

Relation Between the Real Ash and the Sulphated Ash in the Products of the Sugar Manufacture.—Ch. Violette.—In the method of commercial analysis, used in determining the value of sugars, it is admitted that 0·9 of the weight of the sulphated ash represents approximately the weight of the true ash, *i.e.*, that which would be found by the direct incineration of the sample without the addition of acid. In a memoir on crude sugars (*Comptes Rendus*, lxxxvi., 642) the author has shown that this coefficient is too high: 0·8 is much more correct for raw sugars, and for very pure samples it does not exceed 0·7.

Communication on the Destruction of the Phylloxera.

New Experiments on the Alkaline Hydrosulphates for the Destruction of the Phylloxera.—M. Mouill-Fert.

Action of Coal-Tar in the Treatment of Vines Attacked by the Phylloxera.—M. Balbiani.

Employment of Electro-Diapasons of Variable Periods as Tonometers and Electro-Interruptors. – M. E. Mercadier.—Interruptors of this kind have a decided advantage over those of Foucault. They are, at will, either single or double acting. The two electric systems which produce—the one the maintainance of the vibratory movement of the diapason interruptor, and the other the intermittent currents, are distinctly and clearly separated, which is not the case with Foucault's interruptor.

Attempt at a Theory of the Formation of the Secondary Faces of Crystals.—M. Lecoq de Boisbaudran. —Reserved for insertion in full.

Microscopic Study and Proximate Analysis of a Pumice from Vesuvius. — M. F. Fougué. — This pumice is white, very porous, and floats on the surface of water. It is in pieces about the size of a filbert. To the naked eye it appears homogeneous. With the aid of the microscope it is found to consist of a multitude of crystals of amphigene, united by an amorphous vitreous matter. Crystals of horn-blende, pyroxene, peridote, protoxide of iron, felspar, and brown mica are very thinly scattered through the mass. The granules of amphigene have the following composition;—

Silica	56·14
Alumina	24·83
Lime	2·91
Potash	8·73
Soda	6·43
	99·04

Sp. gr. 2·41.

2·00 grms. of the pumice contained—

Pyroxene	1·100
Hornblende	0·340
Felspar	0·120
Protoxide of iron	0·070
Magnesian mica	0·012
Peridote	0·025

Moniteur Scientifique, du Dr. Quesneville, October, 1874.

New Helio-Photometer.—F. Craveri.—A box of hard wood, 280 m.m. long, 145 m.m. wide, and 200 high, forms a parallelopiped placed upon a pedestal in an open situation, where nothing impedes the direct action of the sun. The upper surface of the apparatus cannot preserve, during the twelve months of the year, a horizontal position, because when the sun sinks below the equator in winter its rays would fall too obliquely. It is therefore necessary at that season to follow approximately the movement of the sun. This result is obtained by gradually inclining the instrument towards the south from September to December, and gradually diminishing the inclination again till March, when it is replaced in a horizontal position. One of the principal sides of the parallelogram represents the door, fixed on hinges, and giving access to all the interior. At the side opposite the door is fixed a clock, the dial of which is seen through a circular aperture in the side. To this clock is adapted a toothed wheel, moved by the drum containing the spring. This wheel only performs one revolution in twenty-four hours. To its axle is fixed by a movable screw a large drum of brass, the circumference of which is 520 m.m., and the breadth 16 m.m. Upon the surface of this drum is fixed a slip of paper, as is done with the Morse telegraphs. A few seconds are sufficient for fixing or for removing this band. A slit in the box is so arranged that the sun's rays, shining through it, fall upon the band, even when the uminary is very near the visible horizon. The bands are repared with chloride of silver by being steeped first in a solution of common salt, and then, shortly before being used, in solution of nitrate of silver.

A series of papers from the Laboratory of the Polytechnicum, at Zurich, contain an account of the kawa root, by MM. Mölting and Kopp; a paper by MM. Bibanow on the reactions obtained on melting together certain compounds of aniline and toluydin. The authors have formed magenta by melting together 20 grms. of nitranilin, 40 grms. pseudo-toluydin, and 5 grms. of aniline. The quality of the colouring matter obtained was good, but the yield was small. The same authors give an account of a double chloride of toluydin and zinc, $ZnCl_2+2(C_7H_9NHCl)$.

Barytes Green or Manganate of Baryta. — E. Fleischer.—This salt has been introduced into commerce under the names of Cassel green or Rosenstiehl's green. It has generally been prepared by calcining nitrate of baryta with oxide or peroxide of manganese, or by fusing caustic baryta with manganese and chlorate of potash. The author gives a new method for its preparation. On precipitating a green boiling solution of manganate of potash with chloride of barium, there is formed a deposit, strongly granular, but not crystalline. This precipitate is of a violet colour, bordering on blue. It is well washed by decantation, and then filtered. When dried its colour becomes paler as the temperature rises. At a dark red heat is white, with a slight greyish blue tinge. If heated higher, with access of air, it becomes by degrees completely green, then of a fine blue, and at very elevated temperatures it is converted into a dirty brown grey. If a solution of permanganate of potash is precipitated with chloride of barium, and allowed to boil, there is slowly formed a reddish violet deposit (colour of peach blossom), and the liquid retains an intense violet colour. The precipitate may be washed by decantation, and filtered without decomposition. It can even be dried at 100° without losing its colour. When gradually heated the permanganate of baryta loses its colour like the manganate, but at very high temperatures it behaves differently. When its colour has once been destroyed by a moderate heat it does not become either green or blue by further heating with access of air. The whole becomes at once of a greyish brown. The finest barytes green is formed by calcining the manganate of baryta. Rosenstiehl's process—the fusion of hydrate of baryta with chlorate of potash and peroxide of manganese—yields an inferior colour.

Garnet (or Grenade), a New Dye.—This substance has been introduced as a substitute for orchil. It is perfectly soluble in water, and if used alone produces garnet-browns of great purity. In combination with extract of indigo, turmeric, &c., it may be made to yield every shade of brown with a brightness which orchil cannot equal.

Manufacture of Soda by the Ammonia Process.—Dr. List.—Reserved for insertion in full.

Determination and Assay of Sulphuric Acid.—A. G. Pouchet.—To determine the nitrous compounds in commercial sulphuric acid we take 100 c.c. of the sample, and add to it by means of a burette normal permanganate (1 c.c. = 0·005 grm. pure iron) until a faint permanent rose colour is produced. This operation converts the lower oxides of nitrogen into nitric acid, and sulphurous acid, if present, into sulphuric acid. On the other hand, put in a flask containing 500 c.c., 10 c.c. of a solution of sulphate of protoxide of iron, containing 0·1 grm. of iron. Add the 100 c.c. of the acid previously treated with manganese, and rinse the vessel which had contained it into the flask. Boil, when the nitric acid peroxides a part of the iron, and is reduced to NO_2, which escapes. After boiling for half-an-hour pour into the flask water, previously boiled, enough to fill it three-quarters full, stopper, and let cool. When perfectly cold, titrate with normal permanganate till the faint permanent rose tint appears, noting the quantity of permanate required, whence the amount of nitric acid in the sulphuric acid may be readily calculated. Kolb recommends the following process to determine the nitrous acid in the Gay-Lussac column:—1 grm. of pure dry permanganate corresponds to 0·6 grm. NO_3, and converts it into 0·85 grm. NO_5. The permanganate must not be dropped into the acid, but the acid under examination must be dropped into a known volume of permanganate until the latter is decolourised. Cold dilute nitric acid has no action upon permanganate. Kolb operates upon 0·5 grm. of permanganate in solution, and the volume of acid employed to decolourise it shows the amount of nitrous acid contained. To the liquid is now added a known volume of the normal solution of iron, and the whole is boiled to expel NO_2. Dilute with boiled water, stopper the flask, and when completely cool titrate with normal permanganate. We obtain thus an amount of nitric acid, from which it is necessary to deduct that furnished by the former operation, and which has been calculated into nitric acid. The difference shows the real quantity of nitric acid existing in the volume of liquid used in the first place to decolourise the 0·5 grm. of permanganate. Suppose, for example, that it was needful to use 10 c.c. of the sample of acid to decolourise the 0·5 grm. of permanganate. These 10 c.c. contain 0·300 grm. of NO_3. If, in the second place, it is found by means of the normal solution of iron that the same 10 c.c. of acid contain 0·572 of NO_3, from this quantity we must deduct 0·425 the equivalent in NO_5 of the 0·300 of NO_3. There remains 0·147 of NO_5 for the 10 c.c. of acid operated upon, or in 100 parts—

Nitrous acid	3·00
Nitric acid	1·47

On Ultramarine.—B. Unger.—This paper is too long for insertion.

Liebig's Annalen der Chemie und Pharmacie.
August 29, 1874.

Communications from the Laboratory of the University of Kiel.—These communications consist of a paper by E. Demole on the preparation of glycol; another by the same author on the aromatic hydroxethylen-amines; and one by A. Ladenburg on certain new organic compounds of silicon.

Processes during Incomplete Combustion of Coal-Gas, and on its Behaviour when Heated in the Absence of Air.—R. Blochmann.—As a type of the combustion of coal-gas with an insufficient supply of oxygen, the author takes the flame of a Bunsen burner when it strikes down into the tube. He finds that acetylen is formed by this flame as well as when coal-gas is heated in the absence of air. Hydrogen, marsh-gas, and the other constituents of coal-gas, do not prevent a polymeric condensation of the acetylen formed from the heavy hydrocarbons when gas is heated in the absence of air. The acetylen generated by the "striking back" of a Bunsen flame appears, however, chiefly in a free state.

Dimethyl-Isobutyl-Carbinol, and on the Heptylen obtained therefrom.—D. Pawlow.—This new tertiary alcohol is formed by the action of chloride of valeryl on zinc methyl. It distils over at 129° to 131°. It is a light colourless liquid, almost insoluble in water, of strong camphor-like odour, resembling that of the other tertiary alcohols, and of a burning taste. At −20° it does not congeal but becomes ropy. Its formula is $C_7H_{16}O$. If the iodide of this body is decomposed with alcoholic potash it yields a new heptylen, which boils at 83° to 84°, and has the sp. gr. 0·7144.

On Paramido-Meta-Sulpho-Toluolic Acid.—Dr. H. von Pechmann.—This lengthy paper does not admit of useful abstraction.

Contributions to a More Exact Knowledge of the Starch Group.—Dr. Water Nägeli.—Starch, as we find it in starch granules, consists of a series of modifications, and by means of a further series of such modifications or chemical combinations, it can be finally converted into a kind which takes a yellow colour with iodine, and can be converted into sugar, or split up into two species of sugar. When starch is treated in the cold with different reagents, especially with mineral acids not too concentrated, the part which takes a blue colour with iodine—the blue modification—is extracted, whilst the yellow modification remains behind with the structure of the original granules. The above modifications do not occur in the starch as distinct portions, but are connected by transition stages, which take respectively violet, red, and orange colours with iodine. The yellow modification is the most refractory. It is insoluble in water, and is least easily affected by boiling therein, or by treatment with acids. Its most extreme form, which seems closely related to, or perhaps identical with, cellulose, is almost incapable of being attacked. The most refractory portion forms the capsules or envelopes of the starch grains. The more we approach the blue modification the more soluble and decomposable the substance becomes, its affinity for iodine increasing simultaneously.

Researches on the Source of the Acid in the Gastric Juice.—R. Maly.—The author finds that the pure gastric juice in dogs contains no lactic acid. The decomposition of chlorides by lactic acid cannot, therefore, be the source of the hydrochloric acid in the stomach. Lactic acid seems to play no part in the chemistry of the normal formation of acids. The source of the free hydrochloric acid in the stomach is a process of dissociation of the chlorides without the action of an acid.

Contributions to the Knowledge of Chloral.—O. Wallach.—The author examines, first, the action of aromatic amides on chloral, making especial mention of the behaviour of the latter with anilin, toluydin, and xylidin; secondly, the behaviour of chloral and amidic acids; then of chloral and the salts of aromatic acids; and, lastly, the behaviour of chloral with nitrous acid.

Action of Cyanide of Potassium upon Chlorinised Aldehyds.—O. Wallach.—Not suitable for abstraction.

Meta-Chlorphenol, and its Nitro Derivatives.—A. Faust and H. Müller.—Taken from *Berichte*, v., 777.

Correction of Former Statements Concerning Chloro-Nitrophenols.—A. Faust.—See *Annalen*, supplement vii., 192.

Isononylamid and Isononylic Acid.—H. A. Kullhem.—The author obtained isononylamid, $C_9H_{19}NO$, by setting out from caprylic alcohol. Isononylic acid, $C_9H_{19}O_2$, is almost insoluble in water, readily soluble in ether and alcohol. Its boiling-point is 244° to 246° at 760 m.m. barometric pressure. It does not solidify at −11°. Its sp. gr. at 18° C. is 0·90325. The author describes its soda, potash, ammonia, lime, copper, and silver salts.

Meta-Chlorphenol, and its Mono-Sulpho Acid Derivatives.—J. G. Kramers.—The author has examined γ-chlorphenol-sulphuric acid, and a number of its salts; and δ-chlorphenol-sulphuric acid, and its potash and lime salts.

New Compound from Urine.—F. Baumstark.—The substance in question, $C_3H_8N_2O$, has a strong resemblance to hippuric acid. It forms white columns of several millimetres in length. Freely soluble in boiling water; sparingly in cold water and spirit of wine; insoluble in absolute alcohol and ether. If heated to 250° the crystals experience no change. If more strongly heated they decrepitate, evolve dense white vapours of a peculiar odour, fuse, and finally burn with the odour of horn. It is neutral to test-paper, does not combine with bases, but forms with acids salts which do not readily crystallise and deliquesce on exposure to the air.

Trimethyl-Acetic Acid.—A. Butlerow.—An account of the chemical and physical properties of this acid, and of a number of its salts.

MISCELLANEOUS.

The Royal Society.—The medals in the gift of the Royal Society for the present year have been awarded by the Council as follows, and will be presented at the anniversary meeting of the Society on the 30th inst.:—The Copley Medal to Professor Louis Pasteur, of the Academy of Sciences, Paris, For. Mem. R.S., for his researches on fermentation, &c. The Rumford Medal to Mr. J. Norman Lockyer, F.R.S., for his spectroscopic researches on the sun and on the chemical elements. A Royal Medal to Professor William Crawford Williamson, F.R.S., of Owens College, Manchester, for his contributions to zoology and palæontology, and especially for his investigations into the structure of the fossil plants of the coal measures; and a Royal Medal to Mr. Henry Clifton Sorby, F.R.S., for his researches on slaty cleavage, and on the minute structure of minerals and rocks, for the construction of the micro-spectroscope, and for his researches on colouring matters.

University of London.—The following is a list of the candidates who passed the recent Second B.Sc. Examination:—*Pass List.*—(First Division)—F. H. Barling, Owens College; F. D. Brown, private study; S. A. Hill, Royal Scoool of Mines; J. N. Keynes, B.A., Univ. and Pembr. Camb. Colleges; J. G. MacGregor, Edinburgh University; A. H. Spokes, B.A., University College; A. T. Wilkinson, B.A., Owens College School of Medicine. (Second Division)—F. W. Aveling, M.A., University and New Colleges; P. P. Bedson, Owens College; E. B. Cumberland, private study; G. S. Dunn, B.A., private study; J. Fewings, B.A., Queen Elizabeth's Hospital and private study; W. H. Munns, B.A., University College; P. K. Ráy, University and Manchester New Colleges, and Royal School of Mines; A. H. S. White, B.A., University College; B. A. Whitelegge, First M.B., University College.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in dyeing, and in apparatus connected therewith. Dan Dawson, aniline manufacturer, Milnes Bridge, and Clayton Slater, cotton spinner, Barnoldswick, York.—February 19, 1874.—No. 633. This invention consists in the use of improved means and apparatus for dyeing and "fixing" the dye or colouring matter upon fabrics of cotton or other vegetable fibre or fabrics composed partly of cotton or other vegetable fibre, and partly of wool and other animal fibre, by passing same through the dye-liquor, and then through ammoniacal vapour, and in the apparatus connected therewith.

Improvements in the distillation of essential oils or perfumes. Alphonse Piver, perfumery manufacturer, Boulevart de Strasbourg, Paris. February 19, 1874.—No. 634. This invention relates to a process of distilling aromatic substances at a temperature higher than the boiling-point, that is to say, a pressure of between 1 and 5 atmospheres. The apparatus used consists of a steam generator, a closed vessel to contain the aromatic substances, a cooler or condensing chamber, a vessel divided into compartments by vertical partitions, and intended for regulating the flow of the liquid, and an apparatus for preventing overflow in case of sudden increase of heat. Steam from water or alcohol passes from the boiler into the vessel containing the aromatic substances, and thence, laden with perfume, to a worm in the condensing chamber, whence it runs into the vessel for regulating the flow, passing successively up and down its compartments, a small quantity of essential oil being separated at the top of each compartment and falling into a bottle, the water flowing into another vessel. In case of a sudden rush of liquid the irruptive flow falls into a swing box which brings a funnel under the outlet of the tube of the condenser, and the liquid is conveyed into an open vessel placed under the said swing box.

Improvements in the manufacture of sugar, and in purifying saccharine solutions. John Stenhouse, analytical chemist, Rodney Street, Pentonville, Middlesex. February 20, 1874.—No. 652. The essential features of this invention consists in effecting the removal of lime, existing either as saccharate of lime or otherwise, from solutions of sugar or other saccharine solutions, by means of oxalic acid, or by means of the oxalates of ammonia, potash, or soda, or mixtures of the same.

Improvements in the treatment of sewage, and in the manufacture of manures therefrom. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. February 20, 1874.—No. 653. The object of this invention is the preparation, from the sewage of towns by cleanly and inoffensive processes, of manures suitable to the wants of the farmer as respects their richness in fertilising elements, and also their price and quality.

Improvements in the manufacture of artificial butter. Edward Griffith Brewer, Chancery Lane, Middlesex. (A communication from E. Diderichsen, Copenhagen, Denmark.) February 21, 1874.—No. 661. This consists in making butter from tallow or other fatty matter. It is washed in cold water, cut into pieces, and melted by steam in a wood vessel. Acid soda is subsequently added, and the material boiled several times, adding soda, and finally in pure water; then sifted through flannel, and afterwards churned, fine oil and sour milk being added during the latter process.

Improvements in the extraction of oleaginous matters from wool-washing suds, or other liquids containing soapy matters or grease, and the production of tallow or oil from the resulting substances. Henry Benjamin, Graham's Town, South Africa. February 23, 1874. No. 682. The features of my invention are in the extraction of grease or fatty matters from wool-washing suds, and converting the same into tallow, soap, oil, and such like articles.

A new or improved method of manufacturing artificial butter, and of clarifying or purifying rancid butter. Daniel Hipkins, Tipton, Stafford. February 23, 1874.—No. 684. This invention consists—(1) in making artificial butter by melting fat by means of steam or hot water. The fat is then drawn off and allowed to cool. It is then raised in temperature, and the olein or softer part is removed by pressure from the stearin or waxy part. The olein is then melted, and suddenly cooled by plunging it into or agitating it in a cold liquid, and it thus loses its rough and granulated consistency, and becomes very similar to butter. (2) In purifying rancid butter by melting it and removing any deposit; then boiling it with lime-water or other alkali and allowing it to settle; and, finally, treating the liquor thus clarified by suddenly cooling it in water or other liquid as in the manner first described. The artificial butter, or the clarified butter, may be used separately, or they may be mixed together in any desired proportions, and are perfectly pure and wholesome, and free from deleterious qualities.

Improvements in the construction of furnaces and retorts for the manufacture of bisulphide of carbon. Samuel Henry Johnson, F.C.S., chemist, Lea Bank Works, Stratford, Essex. February 23, 1874.—No. 687. This Provisional Specification describes using a horizontal retort for vapourising the sulphur, and a vertical retort for heating the carbon. Suitable methods of setting the retorts are described.

An improved method of extracting gold from auriferous antimony ores, antimonial compounds, and antimonial mixtures. Tyndall Bright, merchant and ship owner, Liverpool. (A communication from Reginald Bright, merchant, and John Cosmo Newbery, analytical chemist, both of Melbourne, Victoria, Australia.) February 24, 1874.—No. 691. Metallic antimony is fused with ores, compounds, or mixtures, and the gold thereby alloyed with the metallic antimony. The alloy falls to the bottom of the material under treatment, from whence it can easily be removed. When the alloy becomes sufficiently rich in gold—it may be by repeated use—such gold is removed by oxidising the antimony in any of the ways at present known or suitable for the purpose.

A new process for the artificial production of vanilin by means of coniferin, or the sap of plants belonging to the species of conifera, or any other plants related to this family, as an extract of all those parts of the just-mentioned plants containing coniferin. Wilhelm Haarman, Ph.D., analytical chemist, Georgenstrasse, Berlin, Germany. February 25, 1874.—No. 709. Take, first, coniferin; or, secondly, the sap of plants mentioned above which has been purified or liberated from albumina or other impurities; or, thirdly, an extract of all those parts of the just-mentioned plants containing coniferin; or, fourthly, the products obtained from coniferin by means of fermentation, putrefaction, or similar action; and treat one or other with oxidising agents, or such agents of similar action, such as bichromate of potassium and sulphuric acid, or any other peroxide, oxide, acid, or salt, which produce the same effect. The product of the reaction in all these cases is artificial vanillin, which has been proved to be identical in all physical and chemical properties with the aromatic principle obtained by the extraction, &c., of the natural vanilla beans.

Improvements in apparatus for obtaining infusions and decoctions from coffee, herbs, berries, grains, seeds, and leaves. General W. N. Hutchinson, Wellesbourne, near Bideford, Devon. March 2, 1874.—No. 756. Decoctions from coffee are usually made by pouring hot water on the grounds (of the berry) placed in a strainer in an upper vessel, from whence the decoction, when strained, passes into a lower vessel. This arrangement is inconvenient, as under ordinary circumstances it gives such a height to the compound vessel that it cannot stand under the spout of the common breakfast urn, or suspended kettle. It has the further disadvantage that the liquid loses heat in being transferred to the lower cold vessel. Moreover, the compound vessel presents a very large external surface to the cooling influence of the air. The principal object of the present invention is to provide a vessel, whatever may be its material, of so low a shape that coffee can be made in it precisely as tea is usually made. This is effected by placing the filtering vessel *within* the other instead of *above* it, and by forming its sides, and possibly bottom, wholly or partially of a porous quickly-filtrating material or materials. The grains of coffee are placed within the filtrating vessel. Its sides and bottom, which are nearly in close contact with the sides and bottom of the outer vessel, furnish such a large filtrating surface that the hot water which has been added (after standing any required length of time in contact with the grains) will percolate so rapidly through the filtrating vessel as to allow of the liquid being poured out almost as expeditiously as if it were a decoction from tea-leaves made in the usual manner. The pot can be so shaped as to become either a teapot or coffeepot. This method of obtaining decoctions or infusions is applicable to vessels of large size, when a tap might be employed. It promises to be useful for chemical purposes, because the liquid, without coming to the boiling-point, could be conveniently kept at a regulated temperature with the aid of a lamp.

Improvements in preserving eggs. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Dawson Miles, Boston, Mass., U.S.A.) March 2, 1874.—No. 761. This invention relates to an improved mode of preserving eggs, and consists in effecting their condensation by evaporating to a semi-liquid mass, after removing them from the shells, the degree of heat employed being so low as not to prevent them from being afterwards dissolved when required for use; and in the employment of sugar, salt, and sulphite of soda in combination with the eggs.

Improvements in the method of and means for producing electrical signals, and in registering or recording the same. Robert Valentine Dodwell, electrical engineer, Leadenhall Street, London. March 2, 1874.—No. 764. The invention consists in the application and use of a beam or ray of light, suitably prepared by being passed from a battery through an induction coil and vacuum tube, and submitted to the action of an electro-magnet, whereby the ray of light is influenced, and deflections or movements are produced, and signals thereby effected; and in registering or recording such signals upon sensitised surfaces by intensifying the light, and projecting it thereonto by means of a suitable arrangement of lenses.

An improved method of packing or putting-up chloride of lime. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Martin Luther Bush, merchant, New York, U.S.A.) March 4, 1874.—No. 799. The object of this invention is to provide a process or method for putting-up chloride of lime; and consists in the manufacture of a specific quantity of chloride of lime enclosed in a kind of waterproof paper or fabric, which is not susceptible to the corrosive action of the chloride of lime, and which will prevent air or moisture reaching the same, and hence prevent the escape of the chlorine gas so offensive to the olfactory nerves.

NOTES AND QUERIES.

Oxidising Linseed Oil.—Can any of your correspondents inform me what is the best method of oxidising boiled linseed oil so as to obtain the consolidated oil? Is there any quicker plan than exposure to the air?—B.

Writing Ink.—To obtain a good writing ink, dissolve Geigy's soluble aniline black in water. This colour is manufactured by John R. Geigy, Basle, Switzerland, and is much used for that purpose; it can be obtained in this country from W. C. Hood, Walburgh Street, Cable Street, London, E.

Manufacture of Soda.—Being about to investigate the process of manufacturing soda by means of ammonia, I should feel obliged if you will allow me to ask, through your columns, for sources from whence to draw the necessary information. Some papers have, I believe, been published on the subject, but I do not know by whom. If you, or any of your correspondents, would kindly tell me where, and in what works, the process is being carried out, I should feel obliged.—G. C.

MEETINGS FOR THE WEEK.

Wednesday, Nov. 18th.—Society of Arts, 8. Opening Address by Major-General F. Eardley-Wilmot, R.A., F.R.S.
—— Geological, 8.
Thursday, 19th.—Chemical, 8. "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids" (Part II.), by G. H. Beckett and Dr. Wright. "On the General Equations of Chemical Reactions," by W. K. Clifford. "On Propionic Coumarin and some of its Derivatives," by W. H. Perkin. "Action of Bromine on Protocatechuic Acid, Gallic Acid, and Tannin," by Dr. Stenhouse. "On the Composition of Autunite," by A. H. Church.

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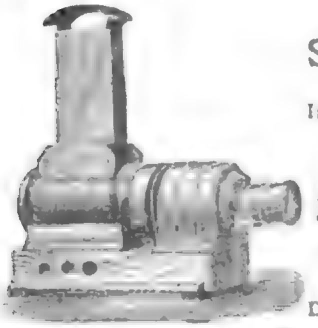

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THE CHEMICAL NEWS.

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CUPROUS CHLORIDE.

By SYDNEY LUPTON.

The following experiments on the formation of cuprous chloride may be of interest to some of your readers. A solution of crystalline cupric chloride is slightly acid to litmus; if such a solution be boiled upon clean copper, a brown solution of cuprous chloride is gradually formed. When the brown solution is poured into water, a copious white crystalline precipitate of cuprous chloride falls; by prolonged standing under water, the precipitate becomes deep orange, from formation of hydrated and anhydrous cuprous oxide, the water at the same time becoming acid.

If pure copper prepared by electrolysis be boiled with strong hydrogen chloride, and a crystal of potassium chlorate be thrown in from time to time, chlorine and its oxides are evolved, and a solution of cupric chloride is formed—

$$KClO_3+6HCl+3Cu=KCl+3H_2O+3CuCl_2.$$

But, if the temperature of the liquid which is still standing over excess of copper be lowered to 70° to 80°, the addition of the chlorate being continued from time to time, a deep brown solution of cuprous chloride is gradually formed.

An identical method has been used by Regnault (*Comptes Rendus*, lix., 319) for covering photographic plates with a film of cuprous chloride.

Other oxidising agents, such as potassium dichromate or bleaching-powder, may be used; but I have found the chlorate to answer far the best, if the solution be kept between the temperatures 70° to 80°.

When common yellow hydrogen chloride and copper turnings are used, the reaction takes place with far greater facility than in the case of the pure substances; the formation of cupric chloride, either at the beginning or end of the process, being inappreciable.

This reaction furnishes an easy and inexpensive means of procuring pure cuprous chloride in the crystalline condition. A flask, containing copper turnings and common hydrogen chloride, is heated to between 70° to 80°, a crystal of potassium chlorate being thrown in from time to time. When the copper is very nearly dissolved, the deep brown solution is poured into water. Cuprous chloride falls as a dazzling white crystalline powder, which is washed once or twice by decantation, to remove potassium chloride and any free acid. The precipitate may then be dried with the usual precautions, or dissolved for use in ammonia or hydrogen chloride.

It is, perhaps, worth while to remark that the cuprous chloride prepared in presence of free acid does not decompose, when kept under water, into the oxide, as that prepared from cupric chloride does, but very slowly forms traces of cupric chloride in solution.

Nov. 12, 1874.

NOTES UPON ANIMAL CHARCOAL.

IRON IN CHAR.

By ROBERT FRAZER SMITH, F.C.S.

(Continued from page 203.)

The method generally followed in Scotch laboratories for the estimation of iron in char is as follows:—

Five grms. are incinerated in a capsule, and the residue washed out into a small flask with strong HCl without filtration. The liquid is boiled, and a standard solution of stannous chloride dropped in till the yellow colour disappears. With all due deference to the highly-experienced chemists who use it, it strikes one that great advantage would accrue to students if they were taught as well the classical permanganate process. Still withal, practised operators get very concordant results.

Expt. 13.—A sample of char was divided into two halves—one treated by tin, and the other by permanganate. Both were calcined before dissolving in acid. Another sample of same char was tested for iron by permanganate without previous ignition; the filtrate from the carbon being titrated.

	Tin.	Permanganate.	
		Previous ignition.	Without ignition.
Fe_2O_3	0·79	0·89	0·89

The solution for permanganate was first treated with SO_2. The HCl solution seems to have had no organic matter dissolved out. The solutions for permanganate were diluted to 250 c.c., and at a temperature not exceeding 13°.

The following analyses of three working stocks and a new home and foreign char may be interesting in view of what I have already said. They were recently analysed in my laboratory.

	1.	2.	3.	4.	5.
Carbon	6·63	15·39	11·56	11·28	11·10
Loss at low red heat in closed crucible	1·88	0·12	4·11	0·31	3·15
Calcic and magnesic phosphates (by difference)	81·04	80·69	75·84	82·18	76·11
Calcic carbonate ..	7·96	0·81	7·55	1·57	6·62
Calcic sulphate ..	1·52	traces	traces	0·17	traces
Ferrous sulphide ..	0·03	traces	traces	0·74	0·23
Ferric oxide	0·19	0·73	0·23	0·41	0·07
Sand	0·75	2·26	0·71	3·34	2·72
	100·00	100·00	100·00	100·00	100·00

No. 1 is from a refinery in which only beet sugar is used, and special means are taken to "degypsumise" the char by alkaline solutions. This stock is twelve months old. (German.)

No. 2 is a stock from an English house, working cane sugar all the year round. Six months old, and carefully handled.

No. 3 is the same char as No. 2, fresh from the maker.

No. 4 is from a foreign refinery working mixed cane and beet. Twelve months old, and badly used.

No. 5 is the same char as No. 4, as received from the dealer.

The sugar from No. 1 is poor in colour, but healthy looking; that from No. 2 is rich in bloom, and in every way satisfactory. The sugar from No. 4 is grey and unhealthy looking.

Expt. 14.—Char which remains exposed to the air for a long time gradually decreases in sulphides. For example, a portion lay upon a cooling-floor two months—

At first contained = 0·080 $CaSO_4$.
= 0·305 FeS.

After one month = 0·120 $CaSO_4$.
= 0·266 FeS.

After two months = 0·180 $CaSO_4$.
= 0·225 FeS.

The iron in char at every revivification is reduced to the metallic state. It is sometimes supposed to be as ferrous oxide, but there can be no doubt that, in presence of so much carbon monoxide and other reducing gases, it passes through the slides in the metallic state. One ton of char from the cisterns (calculated to dryness) will yield at least 600 cubic feet of CO, more than sufficient to reduce all the iron of the most ferruginous char.

Google

Expt. 15.—Twenty grms. of kiln-head char, previously dried at 100°, heated in a tube to the usual temperature of revivification, and the evolved gas collected over water. No attempt was made to analyse the gases, from lack of apparatus at the time; but it was freed from CO_2, and, from the appearance of its flame, it was believed to be CO principally, mixed, no doubt, with marsh-gas, &c. It was inflammable gas, the same as is so frequently seen burning about the kiln-pipes. After making all deductions, 344 c.c. were evolved.

If the temperature of the kiln were too high in presence of calcic carbonate, no Fe would form, but simply FeO; but in no case is the temperature sufficiently elevated to decompose chalk.

Estimation of Carbon in Char.

The estimation of this substance in char is an event of daily occurrence in most sugar refinery laboratories. There is a considerable amount of discrepancy continually being found between the results of different operators on the same sample. For instance:—

Expt. 16.—A sample was halved, and given to two chemists for a carbon determination. A boiled 5 grms. with 40 c.c. of concentrated HCl for half an hour, diluted, filtered, and finished in the same way as B, who boiled his 5 grms. for twenty minutes with 30 c.c. of HCl and 30 c.c. of water.

	A.	B.
Carbon =	10·55 10·52	10·66 10·63

It seems that the proportions used by B are the most reasonable; and only by using uniform quantities of acid and char can the results at one time compare with those at another.

Time is of great importance in laboratories where earnest work is being done, and any proposal to shorten a process should be received with pleasure if the results are equally accurate. On many occasions, twelve to eighteen estimations of carbon are done in a few days. I find, by experience, that washing the carbon with alcohol saves at least two hours on each individual estimation. The time taken by a youth who is fairly dexterous at such work was as follows, comparing the two ways:—

By Alcohol Washing.	By Usual Washing.
Weighing, 5 minutes.	
Boiling, 20 „	
Filtering, 30 „	Drying, 210 minutes.
Drying, 100 „	
Burning, 20 „	
175 minutes.	

Say, three hours; or nearly two hours saved.

The whole process is as follows:—Five grms. are boiled in 30 c.c. of HCl and 30 c.c. of water for twenty minutes. The filter, which has been first moistened with alcohol and dried at 100° till it ceases to lose weight, is then used for collecting the carbon, which is carefully washed with boiling-water till the total washings amount to 200 c.c. After draining, it is finally washed with 40 c.c. of alcohol of 90 per cent, again drained and placed in the bath, dried till the weight is constant. The weights of the same carbon by the two methods will show the completeness of the drying.

	In Water-Bath at 9·15.	
	Alcohol.	Usual.
Filter + bulb =	7·7260	7·6990
1st weighing	8·6900—10·15	9·1100—11·15
2nd „	8·5040—10·30	8·8200—11·55
3rd „	8·4205—10·55	8·4765—12·15
4th „	8·4135—11·10	8·3910—12·45
5th „	8·4135—12·00	8·3905— 1·00
Carbon + silica =	13·75 per cent.	13·83 per cent.

It is not advisable, as recently advocated in the Chemical News, to dry at any greater temperature than 100°. No constant results are got by using the air-bath.

(To be continued.)

LABORATORY NOTES.
PREPARATION OF PURE CARBONATE OF SODA, PURE CARBONATE OF POTASH, AND ABSOLUTE ALCOHOL.*

By J. LAWRENCE SMITH,
Louisville, Kentucky.

From long experience I have found it vain to rely upon manufacturers of chemicals for reagents of that exceeding purity which all analytical chemists often require for conducting their researches, and it has been my habit, through a long experience in analytical chemistry, to prepare with my own hands certain of the chemicals used by me, and, while many of the processes of preparing them embrace nothing specially novel, still my experience in making them has been of certain importance to others, and from time to time I will take opportunities to give more general information of these methods, which may possibly be of service to some, especially as, while seeking first for purity, I have been obliged to economise time by the least amount of manipulation.

Pure Carbonate of Soda.

For many years all the carbonate of soda used by me in mineral analysis has been prepared in the following method, viz., by making oxalate of soda and then decomposing it by heat. It can be described in the shortest possible manner by giving the figures and method employed for obtaining a given result. The carbonate of soda commonly used has been the crystals of ordinary sal soda, washed with a little water to detach the adhering dust, or if one has pure soda at his command it can be used to advantage. The oxalic acid used is the ordinary oxalic acid of the shops once re-crystallised, of which re-crystallised acid I always have a supply of several pounds in my laboratory.

63 grammes of oxalic acid and 143 grammes of sal soda are dissolved by heat in 200 c.c.m. of distilled water—filter the solutions if necessary—to the solution of soda, when cold, add the solution of oxalic acid, just hot enough to keep from crystallising; add it by degrees, stirring well; after the mixture is completed, it is expected that the solution will have an alkaline reaction, to keep any trace of soda in solution; the oxalate of soda will be precipitated in great part shortly after the operation is completed; let stand for a short while to cool completely, decant the supernatant liquid, add a little distilled water, break up with a stirrer the lumps of crystals that may have formed, throw on a filter over a Bunsen aspirator, using a six-inch filter, wash with about a half litre of distilled water, and let dry. This may be placed aside in a glass bottle if not needed at once for forming carbonate of soda; the quantity of dry oxalate produced is 30 grammes. To convert into carbonate project the oxalate little by little into a platinum capsule over a good-sized Bunsen burner; after being strongly heated, the oxalate is decomposed into the carbonate, and, if heated high enough to be fused, will furnish about 23 grammes of fused carbonate of soda; fused or not dissolve in water, filter, evaporate to dryness, dehydrate over a naked flame, and granulate it by stirring when hot.

Double or quadruple the quantities above given may be operated upon at once with similar results. The carbonate of soda thus made is perfectly free from chlorine, sulphuric acid, silica, or other impurity that will interfere with its use in analysis.

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* From advance proofs communicated by the Author.

Pure Carbonate of Potash.

It may be wrong to use the word pure in connection with the preparation of this substance in the manner to be described, as it may contain at the end of the operation a trace of nitrate of potash. The starting point is pure nitre, which is a cheap potash salt, and can be readily purified by repeated crystallisation; the other is oxalic acid, the commercial acid re-crystallised once or twice; 50 grammes of pure nitre and 100 grammes of oxalic acid are placed in a platinum capsule; to this is added a small quantity of water, and heated over a gas-burner; before the mixture is entirely dry, a second portion of water is added and the heat continued until the mass is brought to dryness, at which time nearly all the nitric acid of the nitre is expelled; the heat is now continued and the whole mass brought to redness, breaking up the lumps with an iron rod, when the oxalate of potash formed will be decomposed into the carbonate; the mass is treated with water, filtered, dried, and granulated over the flame; this furnishes about 31 grammes of carbonate of potash, which, as I have already said, may contain a little nitre, but this in no way interferes with the ordinary use of carbonate of potash in making fusions. For this purpose I commonly mix equal parts of carbonates of soda and potash at the time they are required for use.

Absolute Alcohol.

This substance, as obtained in commerce, very seldom marks more than 98 to 99 per cent. It is, however, not unfrequently made in our laboratories, and when this is done the usual method is employed of pouring strong alcohol on lime until the lumps of lime are covered This method of proceeding gives a thick magma which, when heated over a water-bath, allows the alcohol to pass over but slowly, and much of the alcohol is lost from the impossibility of the heat penetrating the thick mass. The method I follow differs from this in no way except in the quantity of lime employed; using the smallest quantity of lime necessary to abstract all the water, it is surprising how complete the lime will perform its function in this respect. Take, for instance, one litre of alcohol of 94 per cent; this contains about 60 grammes of water; if to this be added 120 grammes of good and fresh-burnt lime, requiring about 40 grammes of water to convert it into hydrate, actual experiment proves that when kept in contact with the alcohol a sufficient length of time it accomplishes this absorption of water, and the alcohol decanted from the precipitated lime will be fully 98 per cent.

Operating upon this fact, I have been long in the habit of supplying myself with alcohol of 98 and 100 per cent, by proceeding in the following manner:—I have in my laboratory three or four 2-litre bottles, into each of which I place 1½ litres of 94 per cent alcohol, the strongest alcohol sold in commerce; to this is added 180 grms. of fresh-burnt lime, of the best quality, broken up into a coarse powder. These bottles are set aside on the shelf, and agitated from time to time: the oftener this is done the more rapid will the reaction be accomplished. A week or ten days will usually suffice, when the bottles are allowed to remain at rest, and the hydrate of lime will settle in a few days, and by a syphon two-thirds of the original alcohol can be drawn off free from lime, which marks 98 per cent alcohol, and when filtered and 50 c.c.m. evaporated to dryness there will be left only the merest trace of lime, less than ¼ milligramme. But, of course, re-distillation is so simple that if we wish the alcohol at 98° it can be readily distilled over a water-bath. The magma remaining in the bottle, when distilled over a water-bath, furnishes the remainder of the alcohol about one-half per cent higher.

When absolute alcohol is desired, take the alcohol just as it has been syphoned off or distilled from the magma, put it in a convenient flask for distillation, and to each litre add 120 grms. of lime in coarse powder; attach to a Liebig condenser inverted, so that the alcohol will run back into the flask when condensed: this is continued for an hour and a half or two hours. The condenser is then placed in its normal condition, and alcohol distilled over which will mark 100 per cent. Recently I have learned that there is a method adopted of making the absolute alcohol by one distillation, operating by the inverted condenser first, but in this process the amount of lime called for is the usual quantity, whereas I find that by reducing the lime to its minimum, and always having bottles ready to furnish 98 per cent alcohol, the operation is facilitated, and the loss diminished. So that with the ordinary conveniences and appliances of the laboratory, that are always at hand to be mounted, I can, with fifteen or twenty minutes of *personal attention and manipulation*, obtain a litre or two of absolute alcohol. Of course the time for the reaction of the materials and the distillation is not referred to, as this requires little or no supervision.

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph D.

(Concluded from page 224).

In arriving at the second part of my paper, the conversion of anthracen into alizarine, I am almost afraid of touching it, because the few remaining minutes will only suffice to treat the subject in the most superficial manner, and because I must say a few words on madder and its preparations, the very life and existence of which are seriously threatened by this new industry.

In the East the madder-plant has been known since the earliest times; from there it came to Greece and Italy, thence to the south of France, Alsace, Holland, and Germany. In Holland it has been cultivated more than 300 years; in France it has risen to great importance since the middle of last century, especially in Avignon, which now produces about one-half of all the madder consumed, to the value of about £750,000 per annum. Turkey and South Russia also supply considerable quantities of high quality. Some experiments in cultivating madder in this country have been made in Derbyshire some years ago, but with indifferent results. The soil, the climate, and the weather have the most decided influence upon the growth of the plant, and the subsequent development of the colouring principle. The Dutch madder will dye red, but not purple, and the colour is not fast. Naples madder dyes good red and purple, but the colours are not fast; that of Turkey dyes good red and purple, and is very fast. France supplies the market with two qualities, called "rosées," from their dyeing beautiful reds and pinks, and "paluds," which gives a good purple, besides fine reds, and is the best French quality. The last name is derived from the fact that the plants are grown on marshy land.

The cultivation of the plant and the ultimate separation of the colouring principles is a matter of much time and uncertainty. The root must remain in the ground for a long time—in France two or three years, in Turkey five and seven years—and after having been dried and coarsely powdered, it must be kept another year or two to develop the colouring principles which are not ready formed in the root.

For many centuries, and until the beginning of the present one, the root was used direct, and no attempt was made to separate the colouring matters or to apply them in a concentrated and pure form, but with the develop- of technical industry and scientific investigation the concentration or separation of the valuable constituents gradually commenced. The first step was the manufacture of "fleur de garance" madder deprived of all substances, soluble in water, and then dried again, which reduced the bulk to about 60 per cent. The washings contain a considerable amount of sugar, which by some French manufacturers is converted into alcohol.

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* Read before the Society of Arts, Chemical Section

A ton of madder gives about 15 gallons of alcohol of rather unpleasant flavour, but well adapted for technical purposes.

Garancine is madder further treated with sulphuric acid, which destroys part of the ligneous fibre, yielding about 25 per cent, in the form of a fine powder of light brown colour.

Alizarine verte and purpurine are the results of treating madder with sulphurous acid, which dissolves both: after adding sulphuric acid to the solution and heating to 40° C., purpurine separates about half or three-quarters per cent, and on further heating to 100° C., alizarine verte separates about 3 per cent.

Yellow alizarine is obtained by further purifying this alizarine verte.

Extracts of madder are mostly obtained by treating the root with boiling water, collecting the precipitates which separate on cooling, mixing them with gum or starch, and adding acetate of alumina or iron. This is, in fact, a mixture of colouring matter and a mordant, which may be used for printing direct. These are the principal madder preparations, many of which are manufactured in this country.

In speaking now of artificial alizarine and its manufacture from anthracen, the three principal links in this process are seemingly:—

Anthracen	$C_{14}H_{10}$
Anthrachinon	$C_{14}H_8O_2$
Alizarine	$C_{14}H_8O_4$

The conversion of anthracen into anthrachinon does not offer any difficulty. It has been studied by Anderson long before any practical application ever was thought of.

Chromic acid or nitric acid readily effects the change, but chromic acid is preferable, inasmuch as nitric acid also gives rise to the formation of some nitro compounds. The crude product is readily purified by sublimation, when the anthrachinon is obtained in fine yellow needles, which melt at 275° C.

Anthrachinon strongly resists the action of any oxidising agent, and although Wartha succeeded in converting small quantities into alizarine by heating it with an alcoholic potash solution, still this direct oxidation is practically not possible; it therefore became necessary to further convert anthrachinon into a compound, which, when treated with potash, would yield alizarine.

The methods of converting anthracen, not only into anthrachinon, but into a further substitution compound, form the principal subject of different patents, a short review of which will at once give the history of the rapid development of this new industry.

Graebe and Liebermann, the original discoverers, claim in their first patent the treatment of anthrachinon with bromine or chlorine, thereby obtaining bibrom or bichlor anthrachinon, which, fused with caustic potash, yields alizarate of potash, and this in its turn decomposed by hydrochloric or any other acid leaves alizarine. They also obtain the bromine or chlorine compound without the formation of anthrachinon by acting upon anthracen direct with bromine or chlorine, thus obtaining the tetrabrom anthracen or corresponding chlorine compound; this boiled with nitric acid gives bibrom anthrachinon.

$C_{14}H_{10}$	$C_{14}H_{10}$
$C_{14}H_8O_2$	$C_{14}H_6Br_4$
$C_{14}H_6Br_2O_2$	$C_{14}H_6Br_2O_2$
$C_{14}H_6K_2O_4$	
$C_{14}H_8O_4$	

Broenner and Gutzkow's patent, the next one, is so confused that it is difficult to clearly understand it; but it seems evident among a great mass of irrelevant matter they point out that the above treatment with bromine and chlorine may be substituted by the action of sulphuric or nitric acid. They claim to produce not only alizarine, but also purpurine.

Caro, Graebe, and Liebermann, in another patent, claim the production of the sulpho acid of anthrachinon by treating anthrachinon with sulphuric acid, removing excess of sulphuric acid by carbonate of lime, then adding carbonate of soda, evaporating the solution of the soda salt to dryness, and fusing it with caustic soda or potash.

They also avoid the introduction of anthrachinon by treating anthracen direct with sulphuric acid, and obtain the bisulpho acid of anthracen, which is converted into bisulpho acid of anthrachinon by means of oxidising agents, such as peroxide of manganese.

$C_{14}H_{10}$	$C_{14}H_{10}$
$C_{14}H_8O_2$	$C_{14}H_8(HSO_3)_2$
$C_{14}H_6(HSO_3)_2O_2$	$C_{14}H_6(HSO_3)_2O_2$

The first part of the last patent, viz., the formation of the bisulpho acid of anthrachinon, is also claimed by Perkin in a patent dated one day after Caro, Graebe, and Liebermann's.

Perkin holds also the next patent in which anthrachinon is again avoided. Bromine or chlorine compounds of anthracen are acted upon by sulphuric acid, and the result oxidised by peroxide of manganese. Dale and Schorlemmer have further simplified the reaction; they boil anthracen with sulphuric acid, remove excess of acid by carbonate of lime, and treat the solution with caustic potash and nitrate or chlorate of potash. The last patent has been obtained by Meister Lucius and Bruening; this embodies the treatment of anthrachinon with fuming nitric acid and production of mononitro anthrachinon.

I can do nothing but give the reactions which are intended to be produced, without attempting to allude to the great delicacy of the operations. I need scarcely say that at every step the most attentive care is required, because almost every reaction may either be not carried far enough, or may be carried too far, and in either case total or partial failure in the manufacture must be the inevitable consequence.

I have merely given the seven patents because they will best show the tendency to simplify the original elaborate and costly processes, and that this has been effectually done is shown by the large quantity of alizarine produced, and by the great reduction in price.

The artificial product is mostly sold as paste, which is better applicable than a dry powder, which would not mix so well and uniformly. Of course this paste is not chemically pure; but whereas two years ago many samples did not contain more than 5 per cent of alizarine, the quality has now vastly improved.

Pure alizarine may readily be obtained by evaporating the paste, and then extracting the colouring matter, or by sublimation, as shown by different specimens.

Great doubts were first expressed as to the quality of the dye compared with that of madder preparations, but they seem not to exist any longer: it has been convincingly proved by Bolley, Kopp, Schunck, Perkin, and others, that the natural and artificial alizarine are identically the same, and the same results are produced.

The question of price has also been settled; whereas not two years ago the difference was greatly in favour of madder, it is now about the same, in consequence of the greatly increased production.

There is now one factory in this country, founded by Perkin, one in France, and more than a dozen in Germany and Switzerland. Some idea of the extent of this manufacture may be formed from the fact that last year more than 1,000 tons of 10 per cent paste were produced, in value of £500,000, and it is stated that one German firm are preparing to make 500 tons a year.

The effect upon madder cultivation has naturally been most serious, and especially at Avignon the question is most anxiously discussed whether the artificial alizarine will ultimately drive the madder out of the market altogether. The vitality of the new product is more then secured, but although it must very seriously injure the madder interest, it need not necessarily kill the natural product altogether. There may be room for both, and an increased production may, and undoubtedly will, insure a vastly increased consumption.

Such effect we have seen with the introduction of the aniline dyes; a whole series of new compounds of formerly unknown shades have sprung up of a total value of about £2,000,000 a year, and have they thrown any of the old dyes, madder, or indigo out of the market? No; new applications have been found, more coloured articles of every description are used; and so it will be the same with alizarine—the more it is manufactured, the more it will be used.

No doubt the madder growers will have to struggle hard in the competition, and of this they seem to be aware already. Only the other day the Agricultural Society of Avignon inquired of the Industrial Society at Mulhausen what they had to fear of artificial alizarine. The answer was that to successfully compete, they must improve their product; they must not only sell the raw material, containing but a few per cent of valuable matter, but they must call in the assistance of science; they must manufacture the extracts of such quality as is made in Paris and England; but that it was impossible to drive the artificial product out of the market again. In such manner the artificial alizarine will have the merit of improving the quality of its ancient rival.

But even supposing madder cultivation were destined to die out, would the ultimate general advantage not more than compensate the individual loss? Many thousands of acres of land would be set free, and would with other crops give a better return than now, when the root must remain for years in the ground. Seldom, if ever, have such splendid results been obtained in so short a time. Here we see a most unpleasant and perfectly useless greasy substance suddenly turned into one of the most beautiful colouring matters; a new application for immense quantities of various chemicals is found, a number of important manufactures is started, the effect of which is felt more deeply than we can be aware of. And science itself, in accomplishing this revolution, largely profits by it, because the investigation of all the connecting links has of late years given us an insight into the internal arrangement and constitution of these chemical compounds, hitherto unknown.

To England especially the practical part of the question is of the greatest importance, because, after all, England is the great tar-producing country, and the principal supply of anthracen must always come from here. The nine London gas works alone convert about 1½ millions tons of coals into gas, and produce about 12 million gallons or 60,000 tons of tar a year. The gas companies have not been slow in profiting by this invention; the price of tar has already been more than doubled, an increase almost sufficient to reduce the price of gas a penny or twopence per 1,000 feet.

And finally, must alizarine be the only colour derived from the solid hydrocarbons? It is not very likely that others will be produced from anthracen and its homologues.

Boettger has already separated an anthracen orange of great dyeing power; Springmuhl has succeeded in obtaining a most beautiful blue, the only drawback in the manufacture of which is at present that it would cost about £600 a pound; but one might almost say this is the least difficulty, because the compound once obtained—an easy and economical process of manufacture—is almost sure to follow. But while we are thus waiting for further triumphs in this and similar directions, let us not forget to honour and to admire the perseverance, energy, and industry of those scientific minds who, whatever their nationality, have contributed in solving the great problem of imitating and outrivalling nature's silent working, and who have succeeded in producing on scientific principles one of the most lovely natural colouring matters.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, November 7th, 1874.

Professor W. G. Adams in the Chair.

At this meeting, the first of the session, the certificates of eight candidates for election were read.

A communication was read from Mr. G. F. Rodwell, "*On a New Instrument for Multiplying Small Motions.*" It consists of a train of multiplying wheels, the first of which is moved by the body whose elongation is to be determined, while the teeth of the last engage with the threads of an endless screw, whose axis is vertical, and carries at its upper extremity a long index moving over a graduated circle.

Professor G. C. Foster made a communication "*On the Geometrical Treatment of certain Elementary Electrical Problems.*"

Professor Guthrie read a paper "*On Salt Solutions and Water of Crystallisation.*" The absorption of heat which occurs when a salt is dissolved in a liquid was shown to depend, not only on the relative specific heats of the salt and the liquid, but also upon the molecular ratio of the resulting solution. This ratio declared itself—(1) Optically, by the singularity of the refractive index when the critical ratio was attained; (2) by the singularity of the density at the same point; (3) by the heat absorbed when (α) a saturated solution was mixed with the medium, and (β) when the salt itself was dissolved in a certain quantity of the medium. The condition of maximum density of water was referred to the existence of a definite hydrate of water. It was shown that every salt soluble in water is capable of uniting with water in definite ratio (by weight), forming definite solid compounds of distinct crystalline form, and constant melting and solidifying points. It was supposed that the ratios of such union are not incommensurable with the ratios of chemical weight, and that the new class of bodies which only exist below 0° C., and may be called "cryohydrates," are not discontinuous with the hydrated crystalline salts previously known. A few cryohydrates were described as being obtained from the saturated water solutions of the respective salts on the withdrawal of heat. Thus chloride of sodium combines with 10·5 (? 10) molecules of water, and solidifies therewith at −23° C. Chloride of ammonium combines with 12 molecules of water, and solidifies at −15° C. The combinations with water were given of the sulphates of zinc, copper, sodium, and magnesium; also those of the nitrate of potassium, the chlorate of potassium, and the bichromate of potassium. So far as the experimental results at present indicate, it appears that those cryohydrates which have the lowest solidifying-point have the least water. Some suggestions were offered concerning the application of these experimental results to the explanation of the separation of the Plutonic rocks from one another, and the importance was pointed out of the use which these cryohydrates will have in establishing constant temperatures below 0° C., as fixed and as readily attainable as 0° C. itself.

Lectures on Crystallography at the Chemical Society.—We are glad to be able to state that a considerable number of Fellows of the Chemical Society and others have intimated their intention of attending Professor Maskelyne's lectures on crystallography at the Chemical Society, Burlington House. The lectures wil therefore commence on Monday evening next, at half-past eight o'clock.

CORRESPONDENCE.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—The science of mineralogy appears in a mess, and mineralogists not only in a muddle, but afraid to put their heads together in order to get out of it.

Being the nature of T. A. R. to stick to a subject, I propose, therefore, with your permission, to retain my antiseptic initials, because, I tremble at the very thought of their eminences the cardinals of chemistry and their sovereignty to atomise. It is a little comfort, however, to know that theirs is a limited monarchy, and that they profess only to deal with atoms. But a very small David can fling stones. I flung 150 at once the other day in the hope of hitting, without hurting, somebody whom they might concern. A few of them appear to have fallen harmlessly near Owens College, and Dr. Burghardt has picked them up. Thanks, many and sincere, to him for coming to my aid in an attempt to slay the Goliath of our Mineralogical Babel. Allow me a word in reply to Dr. Burghardt's communication. I have not lately, as he fears, been ransacking ancient mineralogical works. I had once a very long spell at that amusement. A good many years ago I acquired an agreeable habit of collecting stones, with no other object than to observe their differences. I had then only stone-books to look at and read. I was quite happy until I conceived the wild idea of possessing a specimen of every known mineral and a copy of every mineralogical book. The serious question of finance, however, stood in the way for some time. But nearly a quarter of a century ago, I started fairly, as I thought, with a five-and-twenty-guinea collection of minerals, which, together with my own random accumulation, made a tolerably good show. Fortified with the standard books on mineralogy, I thought I might hit what I aimed at. My dismay was not trifling when I found my standard labels covered with synonyms, and my standard authors as much of a hindrance as a help. I therefore gave up the pursuit for a few years. My old love of collecting, however, returning, and being financially improved, I went in rather rashly for more minerals and more mineralogical books. I got more addicted to Stevens's sale-rooms than to a Kursaal, and bought many a hundredweight of both minerals and books. Dr. Krantz also was favourable to my hobby, and Spon very good naturedly got what books I was short of. My troubles now began. My first idea was to accomplish the apparently easy task of making simply a *list* of mineral species and their varieties! I arranged my books in chronological order out of respect to the "Fathers of the Science," and began at the beginning to open a ledger account with each mineral, and to copy into a waste-book all the synonyms. (No small bulk at the present time). I think I have analysed since then every mineralogical treatise in the English language, from Jeffries of 1751 to the present time, resolutely posting my ledger all the while. All I shall say of this labour is, that it has been very like the work of a squirrel in a cage. Hence my list of 150 questionable acquaintances. They are unproductive and a nuisance in my ledger, and I should like them written off my books at once as *bad*. I want, however, those in authority to prove them bad. My ledger has been carefully checked by all the editions of Dana's system of mineralogy. In 1868-9 I went throughout the fifth edition *twice*. The interesting weariness of the occupation reminded me constantly of "doing" twice the Vatican in damp weather. Dana's book is ancient now, as Dr. Burghardt says; but no really big gun has gone off since. An advertisement appeared not long ago that the cumbrous thing had been "re-written and enlarged," and published at 35s. The announcement interested me.

Leisure permitting, I proposed to myself another dead set of a couple of hundred hours at auditing my ledger. I bought the book, but to my annoyance got only 19 pages of *appendix* for my money, the other 827 pages remaining exactly as my old thumbed copy of 1868! This ruffled my feathers a little, and in dudgeon I sent off at once my old list of offenders to the Chemical News, which is, I think, the most appropriate vehicle for perplexing matters of this kind.

Referring to Dr. Burghardt's communication, I am induced to remark that the Beaumontite of Levy is undoubtedly Heulandite, but the Beaumontite of Jackson is said to be "a variety of siliceous malachite, or an allied mineral, containing silica, water, and oxide of copper." (*Watts's Chem. Dict.*, i., 525). Who knows more than this about it? Belonite of Glocker is said to be Aikenite; but Belonite of Zirkel is not; moreover, Zirkel's Belonite and his Trichite appear to be identical; that is to say "microscopic acicular crystals found in glassy volcanic rocks, and may be felspar." Can more light be thrown on this? The "three layers of mineral found in a nodule of amygdaloid" were called by How as follows:—The outer layer Cerinite, the middle layer Centralassite, and the inner bluish mass Cyanolite. Dana says Centralassite is *probably* Okenite; but what exactly about it and the other two so-called minerals?

The Dopplérite of Haidinger and that of Deicke may be both hydrocarbons; but who tells the difference? The Herrerite of Del Rio is an impure Smithsonite according to Dana; or, Hemimorphite according to Maskelyne; but the Herrerite of Herrera is said to be "telluride of nickel with carbonic acid." Who knows and will say whether it is so? Is it meant that Kalkoolborthite is synonymous with Volborthite? I have a specimen of the latter, and have put down the former as a variety, having somewhere heard or read it so. I can't tell where; but no matter, originality in the science is often difficult to determine. Dr. Burghardt writes "Dumasite is Chlorite." I find that I once wrote the same. Dana admits chlorite in his little manual of 1867, and delicately stifles it in his big book of 1868; no account being published of the inquest. Maskelyne refers Chlorite to Clinochlore, Pennine, and Ripidolite: all three. What *is* Chlorite? Some eminent geologists still talk about Chloritic rocks. The Doctor says "Polyhalite is rightly named." Polyhalite of Stromeyer, yes; but I want an authority to say whether the Polyhalite de Vic of Berthier is one and the same thing; probably so; but who will establish the fact? If Zamtite be the Zaratite of Dana, then simply out of compliment to Professor Maskelyne, *Zaratite* should be called Texasite. Alas, poor students with short memories!

By way of gentle mental exercise allow me to introduce a party of the family Antimony with a stranger and an outcast or two just dropped in. Here they are:—Stibite, Stiblite, Stibilite, Stibium, Stibiolite, Stibnite, Stibine, Stibiconite, Stibiconise, Stilbite, and Stillolite. A lisp is not at all ugly now and then amongst the fair sex; but the sibilance in this family, I should think must be, at times, a great bother to professors as well as to students. The list for explanation might be used with varied results in the civil service examination papers. Examiners might perhaps, get over their work pretty quickly.

Some of the present names of minerals are simply silly. Some have been named as being unlike something else; others, because they turned out differently to what was expected of them. Some are worse than bad puns. The agony in bringing forth these abortions must have been frightful. I will give one illustration:—Gahn, a Swedish chemist, finds a puzzling mineral and hands it to Ekeberg, who is astonished to find zinc in such an unexpected place; he reaches down a lexicon and finds that *αυτομολος* means a *deserter*, and he forthwith brands the culprit (who has never run away) with *automolite*. But Von Moll, the next year, thinking this an insult to nature more than to common sense, commanded that it should no more be called Automolite, but *Gahnite*, after the discoverer. Ekeberg, Abich, Genth, and others, called it Automolite, or Automolite, as it might happen, and so do some people now. I think *zinc-spinel* more intelligible; but then it is not classical. Mineral dealers sell us Automolite, Dysluite, and Kreittonite as varieties of spinel. Dana sticks to making them varieties of Gahnite. Maskelyne extinguishes automolite, and makes Gahnite a variety of spinel, which appears the right thing to do.

Please to look at a few modern atrocities. Dana wants people to call Copper pyrites, Chalcopyrite; Steatite, Saponite; Hornblende, Amphibole; Amber, Succinite; Blende, Sphalerite; and common salt, Halite; &c., &c.

Professor Maskelyne wishes Turquois to be called Calaite; but ladies, one and all object; so do the jewellers. What are these resurrectionists about? What is the use of digging up these old coffin-plates?

The premier mineralogists can hardly pretend to infallibility just yet, their allocutions notwithstanding. Is a spade not to be called a spade in future? Are infants to wear succinite necklaces? Are all of us to eschew common salt at dinner, and to "*pass the Halite*" instead? It will be done, I expect, when a cricket-ball shall be called in common a sphere, and a cork-screw Archimedes.

I for one incline to take my stand patriotically by the British Museum; but when Doctors, who are full head and shoulders above me, differ so widely as to what certain minerals should be called, what can a short fellow like me decide?

I append a list of some of the Doctors' differences; be so good as to print it, and by publication help to stamp out this literary scandal, or rather this undignified childish game of 'tis and 'tis'nt.

MASKELYNE *v.* DANA.

Maskelyne.	Dana.	Maskelyne.	Dana.
Allochroite	Andradite	Keramohalite	Alunogen
Alstonite	Bromlite	Kuhnite	Berzeliite
Amber	Succinite	Laumonite	Hypostilbite
Anatase	Octahedrite	Lettsomite	Cyanotrichite
Augite	Pyroxene	Lievrite	Ilvaite
Barytes	Barite	Meerschaum	Sepiolite
Bleinierite	Bindheimite	Melanochroite	Phœnicochroite
Boronatrocalcite	Ulexite	Mispickel	Arsenopyrite
Blende	Sphalerite	Nickeline	Niccolite
Calaite	Turquois	Nickel glance	Gersdorffite
Chalybite	Siderite	Olivine	Chrysolite
Chlorargyrite	Cerargyrite	Onofrite	Tiemannite
Cryolite	Chodneffite	Oxalite	Humboldtine
Copper glance	Chalcocite	Pitchblende	Uraninite
Copper pyrites	Chalcopyrite	Pyrites	Pyrite
Cromfordite	Phosgenite	Salt	Halite
Dichroite	Iolite	Steatite	Saponite
Erubescite	Bornite	Scapolite	Wernerite
Fluor	Fluorite	Selenite	Gypsum
Galena	Galenite	Silicoborocalcite	Howlite
Glaserite	Aphthitalite	Sphene	Titanite
Gymnite	Deweylite	Texasite	Zaratite
Hemimorphite	Smithsonite	Volcanite	Selensulphur
Hornblende	Amphibole	Uwarowite	Ouvarovite
Idocrase	Vesuvianite	Völknerite	Hydrotalcite
Iodargyrite	Iodyrite	Websterite	Aluminite
		Wolfsbergite	Chalcostibite

T. A. R.

Liverpool, October 22.

PS.—I should very much like to back Professor Maskelyne's penny "Index to the Collection of Minerals in the British Museum" against Dana's 35s. volume. The B. M. acknowledges to possessing 668 species of minerals, and 685 varieties, making a total of 1350. From the books I make nearly a thousand more. Dana (1874) makes about 925 species; but the exact number of varieties is what "no fellow can find out." Why these large numerical differences? Our National Collection ought certainly to contain a specimen of every known mineral substance; but, according to its own index, it as certainly does not by a very long way. We ought to know the reasons why from the fountain head. Satisfactory reasons no doubt can be given, and if given would save aspirants in the intensely interesting study of mineralogy a vast deal of rough-hewing, puddling, muddling, and impatience. We appear to want a sort of "New Testament Company" for the revision of our Mineralogical Indices. This might easily be constituted if, as Dr. Burghardt says, "mineralogy has made such rapid strides within the last five years, so that a book dating 1868 is already far behind, and almost useless."

The wearers of the seven-league boots are just the men to do the deed. Where are they? Let them be caught.

T. A. R.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxx., p. 225, I notice from the pen of Mr. G. Combe Stewart, F.C.S., of Cappielow Sugar Refinery, Cartsdyke, by Greenock, a paper in which *he* modestly claims to have discovered FeS in char, which Mr. R. Frazer Smith—a chemist of some seventeen years' experience—has lately been discussing in your columns.

Mr. Stewart refers incidentally to "the shade of dogmatism which Mr. Smith throws over his communication." Without doubt his own is by far the most egotistical production of the two, or, indeed, which I have ever met in your pages.

Mr. Stewart says that *none* of Mr. Smith's statements are new to *him*; and that while studying chemistry in Glasgow, nearly three years ago, he discovered FeS in char. I humbly submit if it is at all probable that one beginning to study the science of chemistry could so soon discover a matter such as this, the existence of which in char has been suspected and sought for by many of long and varied experience: and allowing that he did hit upon it, why did he not publish it ere this time, and receive the honour due, and not claim it when someone else, who had previously done so, was entitled thereto? It is always the person who first makes a discovery public that has the best and foremost claim to the praise.

But had Mr. Stewart read Mr. Smith's papers and letter more carefully he would have observed that Mr. Smith does not state that *he* had *discovered* FeS in char, but simply that he had *proved* its presence, which was *(only) supposed* long ago by Muspratt, but was never verified by experiment.

Mr. Stewart is very fond of using Dr. Wallace's name under which to shield himself; I question, however, if the Doctor will feel flattered to see his name so freely handled by a person of Mr. Stewart's calibre or standing in the chemical world.

He wishes Mr. Smith to consult him, and then he will tell him that he has never overlooked the presence of "these sulphides." Now, Sir, the discussion is about ferrous sulphide, but Mr. Stewart ingeniously omits to say what sort of sulphide he reports in his analyses. I would like to know if he *ever* stated his results as *FeS*, as I have never noticed it put down as such in any analyses but Mr. Smith's; and more, there are chemists in this town, of acknowledged qualifications, who never report the sulphides, either as ferrous or calcium, unless asked to do so.

Mr. Stewart further says that there are a few points in Mr. Smith's annexed analyses which he refrains from touching upon. I defy him to question any of the results therein stated, as I arrived at many of them myself after very careful work, for which in one of his papers Mr. Smith generously gives me the credit.—I am, &c.,

JOHN W. MACDONALD.

Greenock, Nov. 16, 1874.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

Sir,—I notice in last week's Chemical News, page 226. another letter from Mr. Speir, and a copy of a letter he has procured from Dr. Wallace, and annexed report. It appears a rather peculiar proceeding the publishing in a public journal of private documents to satisfy the requirements of a small discussion. As far as I am concerned I regret to take up your valuable space with a personal matter of this sort, but I am not the agressor. The papers I sent to your columns had as their sole object to incite others to publish their experiences, in so far as doing so would not clash with private interests. But I ought to have foreseen that the spirit of the Teutonic epoch still pervades some Greenock refineries. The same dislike to strangers still flourishes strongly among a few who call themselves chemists.

I beg again briefly to state how the matter stands. The origination of the *theory* of the presence of FeS in char was never claimed by me, and cannot be claimed by anyone now living. The *proof* of its presence was afforded by me. If others had previously *proved* that fact, their experiments have never been given to the world. If any such experiments had ever been made they would have been published. Mr. Speir claims to have inferred two years ago that he had found FeS. The laboratory journal shows some estimations of total sulphur, and nothing more, on that point. Eight years' journals kept by that gentleman show nothing but the regulation sugar and char analyses as far as I can see. When I came to the refinery, and not till then, did he become satisfied on the FeS subject. He most courteously intimates that I knew nothing about char till I went to Greenock. If I had depended upon him to lighten my darkness I would have waited long. But I had studied thoroughly the most of what had ever been published upon char, either at home or abroad; and from my employer and others I obtained all the practical information possible. For years I have made chemical technology my favourite study, and been engaged in its practical applications. I worked in the laboratories of Penny, Anderson, Walter Crum, Wöhler, and Fittig; and yet gentlemen who are simply engaged year after year grinding the same monotonous round of sugar and char estimations (work done with perfect and faultless accuracy in some refineries by women), try to make the public believe that they only are competent to analyse char. The fact is, when analyses or consultations of any importance are required the services of men like Dr. Wallace, or Messrs. Patterson and Ogilvie have to be got.

The first two experiments, as well as all the rest, were proposed by me; and Mr. Speir makes a similar mistake to that of his Majesty King George IV., who believed he had commanded a regiment of the guards at Waterloo. He has no more right to claim them than any assistant has who repeats an experiment after his teacher.

With reference to Dr. Wallace's report I do not make, nor ever made, any claim to the discovery of the Speir deposit. I have been simply hitherto a close observer in the refinery, and have taken no part whatever in its management. Mr. Speir is welcome to any credit he may think he has by the deposit.—I am, &c.,

R. Frazer Smith.

IMPORTATION OF SULPHUR.

To the Editor of the Chemical News.

Sir,—In the notes "On the Sulphur Industry of Sicily," quoted in Chemical News, vol. xxx., p. 218, from a foreign publication, it is stated that the import of brimstone into England is decreasing. This was some time ago true; but a greatly increased demand has recently sprung up, for which, in view of the new processes for recovering sulphur from residual products, and of the opening up of enormous mines of pyrites like Rio Tinto, I cannot account. From enquiry at the Board of Trade, I find that the quantities imported in the ten months ending October 31, 1872, 1873, and 1874, respectively, were 878,056, 728,379, and 903,840 cwts. A satisfactory explanation of this would be very interesting.—I am, &c.,

Enquirer.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 14, October 5, 1874.

Exact Values of the Crystals of Titaniferous Iron (Ilmenite).—M. N. de Kokscharow.—The author states that the results of his recent observations have enabled him to deduce the angles of titaniferous iron with absolute precision, and have at the same time demonstrated its tetrahedrism in an incontestable manner. The details would be unintelligible without the accompanying illustrations.

Report on the Freezing Machine, by means of the Evaporation of Methylic Ether, as Designed by Ch. Tellier; and on the Preservation of Food in Air Cooled by this Apparatus.—Not adapted for abstraction.

Temperature of the Sun.—M. J. Violle.—The author concludes that the true mean temperature of the sun's surface is 2000°.

On Magnetism.—M. J. M. Gaugain.—A detailed account of experiments continued from *Comptes Rendus*, January 13, June 30, September 8 and 29, November 10, and December 22, 1873; and March 22, June 1 and 15, and September 7, 1874.

Conductibility of Woody Bodies and Other Substances of Low Conducting Power.—M. Th. du Moncel. —In this paper the author examines the conductibility of minerals. Although displayed to a great extent under the influence of atmospheric moisture, the electro-conductibility of minerals is subjected to molecular conditions, which cause it to vary within wide limits, according as they are the results of fusion, of crystallisation, or of simple aggregation. It is not here the question of metallic particles which may be present, and which may give them a peculiar conductibility, more or less considerable. In all cases it is a general characteristic of the transmission of electricity through minerals to produce phenomena of polarisation, which are scarcely perceptible in case of woody bodies.

Synthesis of Purpurin, and on Certain Analogous Colouring Matters.—M. A. Rosenstiehl.—MM. Schützenberger and Schiffert, in making a proximate analysis of commercial purpurin, discovered in it a small quantity of a yellow substance which dyed aluminous mordants a poor orange-yellow, and had the composition of alizarin or of its hydrate. M. Schützenberger observed, further, that this substance, *purpuroxanthin*, is produced by reducing purpurin either with hydriodic acid, or with protoxide of tin in an alkaline solution. The study of this body has been the starting-point of the author's researches. (1) We readily obtain purpuroxanthin by causing white phosphorus to act, with the aid of heat, upon an alkaline solution of purpurin. This dissolves without disengagement of gas, and the reduction is completed in a few minutes, the colour of the solution passing from violet-red to red, and then to brown. It is poured into acidulated water; the flocculent precipitate is collected, washed, and dried, the yield being almost the theoretic amount. On filtering the alcoholic solution of this body over animal charcoal, and on adding water, we obtain purpuroxanthin in the form of a crystalline powder of a very bright yellow. It readily sublimes in needles, the orange-yellow colour of which resembles that of pure alizarin. It dissolves easily in alcohol, acetic acid, and benzol. Water precipitates it from its alcoholic solution in the form of a translucent jelly, which coagulates by degrees into flocks of greater density. Alkalies dissolve it with a fine red colour. Its lime and baryta compounds are slightly soluble in boiling water, which they tinge of an orange-red. Watery solution of alum dissolves it at the boiling-point, but it separates out almost entirely on cooling. It does not dye the aluminous and iron mordants. Its ultimate analysis leaves no doubt as to its composition, which is represented by $C_{14}H_8O_4$. It is, therefore, an isomer of alizarin, and is probably identical with the alizarin of Rochleder. (2) In an alkaline medium it is not permanently modified by reducing agents. Its red colour is, indeed, altered to a brown, but if poured into acidulated water the original substance is reproduced. Hydriodic acid modifies it profoundly. No definite result is obtained on operating in closed vessels, but in making use of acid boiling at 127°, and of white phosphorus at the ordinary pressure of the atmosphere, we obtain at first a substance of a yellow more greenish than the above, soluble in hydriodic acid, alcohol, acetic acid, and benzol, from which it separates out in brilliant lamellar crystals. It is not capable of sublimation. Its alkaline solution is brown, and is oxidised on exposure to the air, reproducing purpuroxanthin. It dyes aluminous mordants almost like quercitron bark. Its elementary analysis admits either of the formula $C_{14}H_{10}O_4$, or $C_{14}H_{12}O_4$. On prolonging the action of hydriodic acid under the conditions indicated, we obtain anthracen and its two hydrides, which have been distinguished by their physical and chemical properties, as well as by ultimate analysis. Phenanthren was not found among the products of this reaction. Purpuroxanthin, if heated with oxide of zinc, gives rise to anthracen. (3) In a boiling alkaline solution an atom of oxygen attaches itself to purpuroxanthin, and the purpurin is regenerated. It is identical with that of madder. The synthesis of purpurin is thus linked to that of an isomer of alizarin, thus giving a second solution to the problem of the industrial production of this precious substance. (4) Repeating the synthetical experiments of M. de Lalande, the author obtained purpurin identical with that of madder, and with that produced by the oxidation of purpuroxanthin. This artificial purpurin, obtained by the oxidation of alizarin, gives rise on reduction, not to alizarin, but to its isomer, purpuroxanthin, which, when submitted to de Lalande's oxidation process, reproduces purpurin. It is therefore established that two isomeric bodies reproduce purpurin by oxidation, whilst, inversely, the reduction of the latter only gives rise to one of these isomers—the one, viz., which does not possess the attributes of a dye. (5) The author has tried the oxidising action of alkaline solutions upon two other isomers of alizarin—chrysophanic acid, and anthraflavon. The former, heated to 195° in a concentrated alkaline lye, is transformed into a substance possessing the tinctorial properties of the proximate principles of madder. It is much more soluble in dilute alcohol than is chrysophanic acid, and it separates out in the form of a deep red crystalline powder. Its alkaline solution has a shade slightly more violet than that of pure alizarin. It dyes alumina mordants of a garnet-red; those of iron of a greenish blue. These shades resist boiling soap-lye very well. From its origin this body should be an isomer of purpurin. Anthraflavon, according to Barth and Senhofer's description (*Ann. der Chem. und Pharm.*, clxx., p. 100), approximates closely to purpuroxanthin. The authors even indicate that, if heated in an alkaline solution, this takes a very rich violet colour, but they did not interrupt the operation at this point, nor did they isolate the products of the reaction. These, in the crude state, dyed mordants like madder, in identical shades possessing the same solidity. With alum-water they gave a red solution, not possessing, however, the fine fluorescence of purpurin. The proximate analysis of this crude product divides it distinctly into two bodies, one of which, soluble in benzol, dyes mordants like alizarin, from which it differs, however, by its solubility in alum-water. The other dyes alumina mordants like purpurin, but differs from it by its sparing solubility in benzol and alum-water, and by its free solubility in alcohol. Thus anthraflavon, the isomer of alizarin, produces by oxidation simultaneously two colouring matters, which, from their origin, may be isomers of purpurin. The author has compared these various bodies with the isopurpurin discovered by M. Auerbach in the artificial alizarin "for reds," and has proved that it is identical with neither of them. (6) There is a fifth isomer of alizarin, chinizarin, discovered by Grimm. If we admit as isomers the products derived from it by oxidation, and which are all analogous colouring matters of the same solidity as far as chemical reagents are concerned, we are at present acquainted with five bodies of the composition of purpurin. These may be divided into two classes:—To the former belong pseudopurpurin, purpurin, alizarin, purpuroxanthin, and chinizarin; to the second belong anthraflavon and the colouring matters thence derived, anthrachryson, rufiopin, and rufigallic acid.

New Observations on the Composition of the Waters of Bagnères de Luchon.—M. E. Filhol.—A controversial note referring to the paper page 683 of the present volume of the *Comptes Rendus*.

Volumetric Determination of Copper.—M. Pr. Lagrange.—The author states that the volumetric processes for the determination of copper are few in number, and generally little employed (?). His method is based upon the precipitation of the copper from its nitric or sulphuric solution by hydrate of potash or soda; the conversion of the hydrate of cupric oxide thus obtained into cupro-potassic (or sodic) tartrate; and the reduction of this salt to the red anhydrous suboxide by a standard solution of pure glucose.

Spectro-Electric Tube or Fulgurator for the Observation of the Spectra of Metallic Solutions.—MM. B. Delachanal and A. Mermet.—This paper requires an illustration.

On Supersaturation.—M. Lecoq de Boisbaudran.—A critique on two papers by M. Gernez (*Comptes Rendus*, January 26 and July 27, 1874).

Action of Bromine upon Certain Alcohols.—M. E. Hardy.—The alcohols experimented upon are the propylic, butylic, and amylic.

Production of Oxamic Acid by the Oxidation of Glycocol.—M. R. Engel.—In addition to the carbonate, oxalate, and oxamate of potash, there are other substances among the products of the oxidation of glycol, derived from the oxidation of the oxamic acid itself.

Action of Heat upon Diphenylmethan and Phenyltoluen, and on the Products of the Reduction of Benzophenon.—M. Ph. Barbier.—The author proposes to give the result of his experiments, undertaken with the object of effecting the synthesis of fluoren. From diphenylmethan the chief product obtained was anthracen, with a small quantity of phenanthren, but no fluoren. Phenyltoluen, under the same conditions, yielded benzol and toluen, but no anthracen. In all these pyrogenous carbides elementary analysis is insufficient, since they differ in their percentage composition by quantities not greater than the error of the operation.

Curious Association of Garnet, Idocrase, and Datolite.—J. Lawrence Smith.—The author received specimens of a rock containing these minerals from Santa Clara, California. On examination they were found to consist of calcareous spar, datolite, garnet, and idocrase. The datolite is colourless, crystalline, and perfectly pure, as may be seen from the subjoined analysis:—

Silica	38·02
Boracic acid	21·62
Lime	33·87
Water	5·61
	99·12

This mineral has not previously been found associated with garnet and idocrase. The garnet is of the variety known as cinnamon-stone (essonite). The crystals are large perfect dodecahedra, green without, and of a cinnamon colour within. Their analysis gave—

Silica	42·01
Alumina	17·76
Ferric oxide	5·06
Oxide of manganese	0·20
Lime	35·01
Magnesia	0·13
	100·17

Specific gravity, 3·59

The idocrase forms fibro-compact crystals of a green colour. It interpenetrates the garnet crystals, so that it is difficult to say where the one ends and the other begins. Its composition is—

Silica	36·56
Alumina	17·04
Ferric oxide	5·93
Oxide of manganese	0·18
Lime	35·94
Magnesia	1·07
Potash	0·51
Loss by fire	2·00
	99·23

Specific gravity, 3·445.

Spectroscopic Observations made during the Balloon Ascent, September 24, 1874, to Study the Variations and Extent of the Spectral Colours.—M. W. de Fonville.—The author used a spectroscope of Lentz, with a graduated slit arranged so that it was possible to look directly at the sun. Three different observations were made between 1500 and 1000 metres. The blue colour invaded the space occupied by the indigo and violet rays, whilst the red rays appeared the same as on the earth. When the balloon had descended to the upper surface of the clouds the violet and indigo resumed their usual places.

Liebig's Annalen der Chemie und Pharmacie.
September 19, 1874.

Behaviour of Ozone with Water and Nitrogen.—L. Carius.—The author refers to the contradictory results obtained by previous observers, and to his own papers (*Berichte*, v., 520), showing that ozone is abundantly absorbed by water without any change, that even in presence of nitrogen no peroxide of hydrogen is formed, and that nitrogen is not oxidised in presence of water. The proof that ozone can be absorbed in water is easily furnished by passing at low temperatures into water ozonised oxygen gas, containing not less than 0·5 per cent. The water quickly assumes the smell of ozone, and displays its characteristic reactions. Ozone, as generally obtained, is contaminated not merely with oxygen, but with hydrogen, nitrogen, and its oxides. Hydrogen is indifferent. Free nitrogen, the author has shown, in opposition to the common view, to be likewise without influence. If the oxides of nitrogen meet with ozone in presence of water they are quickly oxidised to nitric acid, thus reducing the quantity of ozone in solution, or in some cases making it disappear altogether. Schœne's recent observation, that in presence of water ozone is converted into common oxygen, is also of importance. A variety of experiments confirmed the author's earlier result that, in presence of water, and at medium temperatures, nitrogen is not oxidised by ozone, and water is not converted into peroxide of hydrogen. The author holds that solutions of ozone containing not more than 5 volumes in 1000 have so characteristic an odour that they cannot be confounded by any experienced chemist with solutions of nitrous acid, chlorine, chlorous or hypochlorous acid. Sensitive litmus-paper is quickly bleached by concentrated ozone water; dilute solutions produce, before complete decolourisation, a peculiar shade resembling imperfect reddening by an acid. Concentrated ozone water bleaches indigo, colours tincture of guaiacum deep blue, liberates iodine from iodide of potassium, and converts it into iodic acid. Solution of thallous oxide produces a brown precipitate, readily in strong solutions, slowly in weak ones. The author has not succeeded in producing peroxide of silver even with the most concentrated ozone water. What effect the absorbability of ozone in water may have is difficult to say.

Formation of Nitrous and Nitric Acids, and of Peroxide of Hydrogen in Nature.—L. Carius.—Oxides of nitrogen may conceivably be formed from free nitrogen by electric discharges in the air during the oxidation of other bodies in the air; oxidation of nitrogen by means of ozone, and formation of nitrite of ammonia by the evaporation of water in the air. The author finds that the two last-mentioned phenomena are not attended with the production of nitrous or nitric acids. These acids may also be supposed to be formed by the oxidation of ammonia, whether caused by electric discharges, by the presence of alkaline bodies, or by ozone. Experiment showed that the acids in question are actually formed in all these cases.

Dimethyl-Ethyl-Acetic Acid.—A. Wischnegradsky.—This acid, an isomer of capronic acid, is a colourless liquid insoluble in water, possessing a faint odour of the fatty acids. It congeals in a mixture of salt and snow, and becomes liquid again at −14°. Its composition is $C_6H_{12}O_2$.

Palladious Oxide in Hydrogen Gas.—Berzelius observed that palladium with a blue tarnished surface loses its blue colour at common temperatures on exposure to hydrogen gas. The black oxide obtained by heating the nitrate is also immediately reduced without the aid of heat.

Oxidation of the Oxy-Acids of the Fatty Series.—N. Ley and A. Popoff.—A theoretical paper.

Peucedanin and Oroselon.—H. Hlasiwetz and H. Weidel.—Peucedanin is to be considered as the keton corresponding to the aldehyd, orselon.

Preparation of Iodine Substitution-Products According to the Method with Iodine and Oxide of Mercury.—P. Weselsky.—The author has prepared and examined the mono-iodo-salicylic and di-iodo-salicylic acids, iodoxy-benzoic acid, mono- and di-para-oxy-benzoic acids, nitro-di-iodo-phenol, nitro-iodo-salicylic acid, nitro-iodoxy-benzoic acid, nitro-iodo-para-cxy-benzoic acid, ortho-nitro-di-iodo-phenol, and nitro-di-iodresorcin.

NOTES AND QUERIES.

Carbolic Acid.—Will some correspondent kindly give all the known methods of detecting carbolic acid in solution, the writer being under the impression that he has found a new method of detecting it?—Carbolic Acid.

Manufacture of Soda.—Ammonia Process.—G. C. will find a paper on this subject in *Dingler's Polytechnisches Journal*, t. ccxii., p. 507 (June, 1874, No. 2), by List, and a translation of it in the *Bulletin de la Société Chimique*, t. xxii., p. 320 (October, 1874); and I see a translation of an article by List from another source is announced for a future number of the Chemical News. G. C. will also find papers in the *Bulletin*, t. xix., p. 270; t. xx., p. 522; t. xxi., p. 432; and t. xxii., p. 90; and in recent numbers of *Dingler's Journal*.—J. Cox.

MEETINGS FOR THE WEEK.

Monday, Nov. 23rd.—Birkbeck Scientific Society, 8. "Water," by J. H. Shirley.

Wednesday, 25th.—Society of Arts, 8. "On School Buildings and School Fittings," by T. Roger Smith.

THE CHEMICAL NEWS.

Vol. XXX. No. 783.

ESTIMATION OF CHICORY IN COFFEE.

By J. R. LEEBODY, M.A.

I have found the following method of applying the colorimetric process for estimating the relative proportions of chicory and coffee in a mixture very convenient.

Take one gramme of the unknown mixture, and one gramme of a standard mixture of equal parts chicory and coffee, and remove all the colouring matter from each sample by repeated extraction with boiling water. Make the cooled extract from each up to the *same* volume (actual volume of no consequence, about 700 c.c. a convenient amount), and filter off a portion for the assay. Put 50 c.c. of the filtered extract from the *unknown mixture* in a Nessler cylinder, and determine by trial how many c.c. of the extract from the *standard mixture*, together with sufficient distilled water to make up to 50 c.c., will give the same colour. Let A c.c. be required, then, assuming the tinctorial power of chicory to be m times that of coffee, the percentage (x) of chicory in the sample is given by the formulæ—

$$x = A\frac{m+1}{m-1} - \frac{100}{m-1}$$

If m were an absolute constant, and definitely determinable (which unfortunately is not the case) this formula would give results of perfect accuracy. Closely accurate results are, however, obtained in practice by taking $m=3$, when the above formula is written—

$$x = 2A - 50.$$

Modifications in the proportions of the ingredients in the standard mixture, and in the formula employed, will, of course, be required for the examination of samples containing more than 50 per cent of chicory.

Magee College Laboratory, Londonderry,
Nov. 17, 1874.

ON THE DETERMINATION OF IRON IN IRONSTONES.

By A. ESILMAN.

As one accustomed to the analysis of clayband and blackband ironstones, may I offer some suggestions relative to the difficulties which Messrs. Stock and Jack encounter in the determination of iron in such minerals (Chemical News, vol. xxx., p. 221).

Their obstacle seems to be the presence of coaly matter and sulphide of iron, which act during the estimation like proto-salts of iron, and cause high results. I do not know if any other chemist has observed the reaction to which they attribute the reduction of perchloride of iron, and I think its occurrence most improbable. Is it not more likely that the decomposition is simply analogous to that which takes place when easily decomposed sulphides are treated with solution of per-salts of iron, resulting in the reduction to proto-salt of the iron and liberation of sulphur? Massive iron pyrites is only slightly decomposed in this way, but it is very probable that the form of pyrites doubtless occurring in iron ores, similar to coal brasses, is attacked by acid solutions of perchloride of iron at the boiling temperature. All alkaline and earthy sulphides, sulphides of iron represented by the formulæ FeS, Fe_7S_8, and Fe_2S_3, sulphides of zinc, lead, cadmium, &c., and more difficultly sulphide of copper, are decomposed in this manner.

If Messrs. Stock and Jack would boil with *dilute* hydrochloric acid the finely powdered ironstone, *invariably* filter off the insoluble matters, and determine the iron by the bichrome method in a solution nearly warm, and not boiling, their difficulties would vanish. A fresh portion, calcined, and fused with bisulphate of potash, gives the total iron in a soluble form to hydrochloric acid. I have invariably found fusion with bisulphate capable of freeing siliceous matters from iron in less time and at lower temperatures than fusion with alkaline carbonates.

Reduction of peroxide of iron by stannous chloride seems to me objectionable where there is organic matter present. In the first place it must be done in a highly concentrated acid solution, when each drop taken out to ascertain the progress of the reduction represents a notable quantity of the substance under examination; and secondly, it is difficult to remove excess of the reducer. A much more preferable plan to me seems to be the addition of ammonia and sulphide of ammonium in excess, then ebullition with excess of hydrochloric acid to expel the sulphuretted hydrogen, then filtration from sulphur. This does not take long time and is very exact.

Under any circumstances titration of the iron by bichrome at the boiling temperature is quite unnecessary. A cold solution may indeed be used, if the final reactions be not too hurriedly noted, while at a warm temperature the organic matter dissolved from the coaly matter of an ironstone does not interfere. For this reason, also, Dr. Penny's method is often preferable to the permanganate process, which a writer in this weeks Chemical News enthusiastically terms "classical."

Manchester, November 21, 1874.

RESEARCHES ON THE COLOURING MATTERS OF MADDER.

By A. ROSENSTIEHL.

Since the publication in 1864 of the researches of MM. Schützenberger and Schiffert on commercial purpurin, it has been generally admitted that four colouring matters exist in madder—alizarin, pseudopurpurin, purpurin, and a hydrate of the latter. The author has prepared these bodies in the state of purity in order to take account of their part in dyeing. He has found that the two latter bodies are formed at the expense of the pseudopurpurin under the conditions of industrial treatment. He has studied the products of the reduction of purpurin, to regenerate it from these products, and finally to obtain two of its isomers, one of which differs from it very little in tinctorial properties, and has been obtained synthetically, taking benzoic acid as a point of departure. Alizarin prepared by the procedures described in books is not pure. After sublimation it must be re-crystallised a great many times from alcohol, until a dyeing experiment proves the identity of two consecutive mother-liquors. To abridge these operations he heats commercial alizarin for some hours to +200° C. with water containing a little caustic alkali. The foreign matters are totally destroyed, the alizarine only partially. He then purifies the crude result of this operation by crystallisations. Pure alizarin stirred up in distilled water dyes mordanted tissues very imperfectly. The mordants do not become saturated unless an aqueous solution of carbonate of lime is added to the dye-bath. The effect is at its maximum when the quantity of lime corresponds to a monocalcic compound of alizarin. A larger proportion is hurtful from the formation of a bicalcic lake which does not dye. Aluminous mordants upon tissues not oiled take a shade much nearer violet than with alizarin prepared according to known methods. It is the O – 1 violet-red of Chevreul's chromatic circles, and very far from what is known as a madder-red. Iron mordants dye a shade which appears to me to be near 1 violet blue lowered $\frac{1}{10}$ to $\frac{8}{10}$. This particular shade of violet, which is in great request, as well as the resistance of the dye to light and to boiling soap-lye, and its behaviour as a dye with distilled water, distinguish alizarin from the other colouring matters of madder.

Pseudopurpurin, discovered by MM. Schützenberger and Schiffert, forms with alizarin the bulk of the colouring matter contained in madder. It dyes only in distilled water. An amount of carbonate of lime equivalent to a monocalcic lake converts it entirely into an insoluble compound, which carbonic acid is unable to decompose. Aluminous mordants take shades bordering upon those given by alizarine; iron mordants take a violet-grey (5 violet blue $\frac{8}{10}$ or $\frac{6}{10}$). These colours are not brightened by soap baths, but quickly degraded, which distinguishes them from the other madder dyes. Pseudopurpurin is very unstable. Boiling alcohol at 90 per cent, as well as boiling distilled water transforms it in three hours into a mixture of purpurin and of its hydrate. On comparing the formulæ of these two bodies, $C_{14}H_8O_6$ (pseudopurpurin) and $C_{14}H_8O_5$ (purpurin), it appears that the water and the alcohol effect a true reduction, which in the case of water especially can only take place at the expense of a part of the pseudopurpurin itself. The reduction goes farther; there being always simultaneously formed a small portion of purpuroxanthin, $C_{14}H_8O_4$, an isomer of alizarin, two atoms of oxygen being withdrawn without the concourse of any foreign reducing agent.

This remarkable reduction may be effected at temperatures below 100° if we operate upon crude pseudopurpurin, or upon madder (previously washed) in presence of acidulated water, or an aqueous solution of alum, which is a good solvent for this substance. In this case, it is probably one of the proximate principles of madder which effects the reduction.

According to the above, pseudopurpurin cannot exist in the commercial derivatives of madder which have undergone the action of hot acidulated water, such as garancin, garanceux, and the various extracts of madder. It is only found in madder, fleurs de garance, and commercial purpurin, as prepared by the process of E. Kopp. It is always accompanied by the products of its reduction, purpurin, its hydrate, and purpuroxanthin. On account of the facility with which it forms an insoluble lime lake, and its want of resistance to clearing agents, pseudopurpurin plays no part in dyeing, and only becomes useful by its conversion into purpurin. Nevertheless it has not been without its applications. It is the colouring matter of madder-lake, which gives very bright rose shades.

Purpurin was obtained by MM. Schützenberger and Schiffert by heating pseudopurpurin to +200° with alcohol, or by sublimation. In either case there is destruction of a considerable part of the substance. We have seen above that the transformation may be accomplished by reactions less energetic, and with a smaller loss of material. Purpurin readily dyes mordanted stuffs in distilled water. The addition of a quantity of lime corresponding to a monocalcic lake is not hurtful, but a larger proportion leads to the formation of an insoluble tricalcic lake which does not dye, and which carbonic acid decomposes with great difficulty.

The shades obtained with purpurin differ much from those produced by the two colouring matters above mentioned. Alumina gives 4 violet-red; the red as almost as violet as, and at the same time brighter than, that produced by alizarine. Iron mordants give 2 violet-blue $\frac{8}{10}$.

These shades are not stable; the operations of *avivage* and soaping rob them of their violet tone; the red becomes 0 or 1 red of the chromic table, but has much lustre. The violet is weakened and dulled.

He has obtained hydrated purpurin (Schützenberger's orange matter) on precipitating with an acid a solution of purpurin in an alkali or in alum water. With calcareous water it behaves almost like purpurin. The shades which it dyes resemble those of purpurin after they have passed through a soap bath. It appears as if the transformation of purpurin into its hydrate takes place upon the fibre. The reds and roses produced by these bodies are as solid as those obtained from alizarine, but they resist light less perfectly.

The different facts announced explain what takes place in dyeing and clearing madder colours. The madder-red and the fine rose produced with fleur de garance cannot be obtained with alizarin alone, as the concurrence of purpurin or of its hydrate is indispensable.

By treating pseudopurpurin and purpurin with reducing agents, we never obtain alizarin, but its isomer purpuroxanthin. The conversion of purpurin into alizarin under the action of heat, though admitted by several chemists, especially M. Bolley, did not succeed.—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 19th, 1874.

Professor Odling, F.R.S., President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the following names were read for the first time:—Messrs. E. Wethered, W. H. Symons, W. Wade Hyde, J. A. Kendall, D. Bendix, J. McDougall, H. Penley Harris, G. Phillips, and E. Sonstadt. For the third time—Messrs. F. W. Bayley, James Forbes, Jun., Edwin Lawson Koch, M.D., Frederick Baden Benger, and Louis Siebold, who were balloted for and duly elected.

The first paper, "*On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids (Part II., Butyryl and Benzoyl Derivatives of Morphine and Codeine),*" by G. H. Beckett and C. R. A. Wright, D.Sc., was read by the latter. By the action of butyric acid and butyric anhydride on codeine, *dibutyryl codeine*, $C_{36}H_{40}(C_4H_7O)_2N_2O_6$, is formed; it does not crystallise, but its hydrochloride does. On heating codeine to 130° C. for four hours with benzoic anhydride, a crystalline base, *dibenzoyl codeine*, $C_{36}H_{40}(C_7H_5O)_2N_2O_6$, is obtained; the hydrochloride crystallises with difficulty. The action of butyric acid on morphine yields a crystalline *dibutyryl morphine*, $C_{34}H_{36}(C_4H_7O)_2N_2O_6$, whilst excess of butyric anhydride, as in the case of the acetyl compounds, gives *tetra-butyryl morphine*, $C_{34}H_{34}(C_4H_7O)_4N_2O_6$; neither this base nor its hydrochloride are crystalline. The author has also prepared *acetyl-butyryl morphine* and *acetyl-benzoyl morphine*.

It would seem that, when these bases are boiled with water, the acetyl compounds decompose more readily than the butyryl ones, and these, again, than the benzoyl ones. In conclusion, he tendered his thanks to Messrs. Macfarlane and Co., of Edinburgh, for the large quantities of pure bases they had presented to them for the purpose of making these experiments.

The President said he was sure the Society would appreciate the liberality of Messrs. Macfarlane, and at the same time congratulate the authors on the successful results of their investigations. It would seem probable that the hydroxyl was acid rather than alcoholic, since the more powerful acid radicals in the new bases were more easily displaced by treatment with water than the weaker ones. Could Dr. Wright suggest any reason why morphine gave tetra derivatives, whilst codeine gave only di derivatives?

Dr. Wright replied that experiment had shown that morphine and codeine were related in the manner shown by the formulæ—

$$C_{34}H_{34}N_2O_2\left\{\begin{array}{l}OH\\OH\\OH\\OH\end{array}\right. \quad \text{and} \quad C_{34}H_{34}N_2O_2\left\{\begin{array}{l}OH\\OH\\O(CH_3)\\O(CH_3)\end{array}\right.$$

Since the former contains 4OH, and the latter only 2, morphine may yield tetra derivatives, whilst codeine only gives di derivatives. The nitrogen in the base, moreover, is triad, and, as it may become pentad, we find these bases will combine with ethyl-iodide, yielding a new series, an account of which he hoped shortly to lay before the Society.

Professor W. K. **Clifford** then made a communication "*On General Equations of Chemical Reactions.*" The speaker said that any one who had been occupied in speculating on the causes of physical phenomena would occasionally come to a point of junction, as it were, between chemistry and physics; such a point was the kinetic theory of gases. From the physical properties of gases, we know that a given volume of each gas under similar circumstances contains the same number of molecules; moreover, certain phenomena which might be called physical were explained by some chemists in one way, and by some in another. For instance, on passing an electric spark through a mixture of equal volumes of hydrogen and chlorine, a product is obtained occupying the same volume as the original mixture, and this is generally explained by saying $H_2+Cl_2=2HCl$, the molecule of hydrogen and of chlorine being each made up of two equal and similar structures; whilst Sir B. Brodie in his hypothesis, expressed thus, $a+a\chi^2=2a\chi$, assumes that the chlorine molecule $a\chi^2$ contains hydrogen in it. These differences had led the speaker to consider the evidence in favour of the two hypotheses, and, although he found that chemical phenomena could be simply explained by the first, yet there was no evidence to exclude the second. He had, therefore, endeavoured to find a general equation which must include all hypotheses, and which would express merely the facts; thus, 1 vol.+1 vol.=2 vols., or $a+b=2c$, expresses merely the results of experiment. Suppose a and b to be complex, and to contain some factor common to both a and b, then their sum, $p+q$, must be an even number, since in the product, $2c$ is an even number, and the part in common must be equally distributed over the whole number of molecules in the product (since the molecules in $2c$ are equal to the sum of those in a and b); again, if $p+q$ is an even number, $p-q$ must also be even, so that, if there is any common constituent in both a and b, the number in which it exists in a over that in b is an even number. Express this by x, then the other factors, yy and zz, not common to a and b, must necessarily be even numbers. The equation $a+b=2c$ can, therefore, be written $xyy+xzz=2xyz$. There is no supposition involved in this equation, which merely represents facts, and any reaction where there is no reduction of volume, such as $H_2+Cl_2=2HCl$, must be represented by it. It will be seen that it contains both the hypotheses previously alluded to.

In the equation $a+2b=2c$, the particular case of which is $O_2+2H_2=2OH_2$, what is common to a and b must be even, and what is not common must be contained an even number of times in a; the equation therefore becomes $xxyy+2xz=2xxyz$, which conclusively proves oxygen to have a double structure. By parity of reasoning, the most general form of the equation $a+3b=2c$, of which a particular case is $N_2+3H_2=2NH_3$, is $xyy+3xzz=2xxyzzz$.

If now we assume that equal volumes of nitrogen and oxygen combine to form the compound NO, or that $N_2+O_2=2NO$, an equation of the form $xyy+xzz=2xyz$ $(a+b=2c)$, then, since b, or xzz, is known to have a double structure, O_2, x must be double, and xyy, or nitrogen, must be double, N_2; and as $xyy+3xzz=2xxyzzz$ $(a+3b=2c)$, therefore, xyy, or a, which represents the hydrogen, must have a double structure, H_2. The equations in general use are thus proved to represent facts, and are not merely hypotheses.

The **President** said they were all much indebted to Professor Clifford for showing us that the form of equation in common use may be established by facts, independent of hypothesis. In writing the equation $H_2+Cl_2=2HCl$, an assumption seems to be made that hydrogen and chlorine have nothing in common, and probably the majority of chemists are not generally aware that they are in this case making any assumption whatever.

Dr. **Wright** said there was one thing assumed in stating the mathematical hypothesis, and that was the existence of molecules, which was the point in dispute. He would like to know whether all the phenomena known to physicists could be accounted for by the molecular hypothesis; for instance, whether there were recorded observations of any law of force which would account for diffusion, dilation, viscosity, cohesion, &c.?

Mr. J. A. R. **Newlands** said, the fact that the combination of 2 vols. of hydrogen with 2 vols of chlorine produced 4 vols. of hydrochloric acid was, of course, well explained by supposing that the hydrogen molecules and the chlorine molecules consisted of double atoms. Still, a mathematical objection might be made to the formula $H_2+Cl_2=2HCl$, on the ground that it was difficult to conceive that one molecule or double atom of hydrogen, or of another element, could by itself occupy any space at all beyond that actually filled by it, and therefore to speak of the volume of one molecule was not correct. Whatever objections might be urged against the atomic view of matter, there could be no doubt that the idea of atoms was an exceedingly useful aid both to teaching and research.

After some remarks by Dr. **Pike** and Mr. **Friswell**, on the spectral lines common to the elements and to some of their compounds,

Professor **Clifford** replied that he had approached the subject from the physical side, and there was no doubt that the kinetic theory of gases, which is merely an expression of facts in another language, amounts to an absolute demonstration of the existence of molecules. For diffusion and viscosity, very exact laws had been deduced, which were in accordance with the kinetic theory. This theory was only just beginning to be applied to liquids, but for gases it had ceased to be of the character of an hypothesis.

A paper "*On Propionic Coumarin and its Derivatives,*" by W. H. **Perkin**, F.R.S., was then read by the author. This compound was prepared by acting on the hydride of sodium-salicyl with propionic anhydride obtained from ethylic cyanide: after washing with water and distillation, it was crystallised from alcohol. It forms beautiful transparent oblique prisms, having the composition $C_{10}H_8O_2$. It melts at 190°, and possesses an odour almost identical with that of ordinary acetic coumarin. The *β-bromo-coumarin*, $C_{10}H_7BrO_2$, is obtained on substituting hydride of sodium-bromo-salicyl for the sodium-salicyl in the above-described process, and also on adding excess of bromine to propionic coumarin. It contains the bromine in the C_6 group, and crystallises in long, thin needles, which melt at 146° and dissolve easily in boiling alcohol. The *β-dibromo-coumarin*, $C_{10}H_6Br_2O_2$, is obtained on heating propionic coumarin to 150° C. with twice its weight of bromine dissolved in carbon disulphide. Exposed to the vapour of bromine, propionic coumarin absorbs it, and forms a viscid liquid, which appears to be a dibromide, corresponding to the dibromide obtained from ordinary coumarin; whilst with fuming sulphuric acid, it yields sulpho-propionic coumarilic acid. The baric salt forms small brilliant crystals of the formula—

$$C_{20}H_{14}O_4BaS_7O_6.10aq.$$

The **President** having thanked the author,

Professor A. H. **Church** read a communication "*On the Composition of Autunite.*" From the results of the author's analysis, autunite, as it exists in the unaltered crystals, is—

$$\left.\begin{matrix}U_2O_3\\CaO\end{matrix}\right\} P_2O_5,10H_2O$$

when dried *in vacuo*, however, it loses eight molecules of water, and becomes—

$$\left.\begin{matrix}U_2O_3\\CaO\end{matrix}\right\} P_2O_5,2H_2O,$$

the remaining two molecules of water not being driven off at 100° C. The corresponding mineral, torberite, with which it was long considered to be isomorphous, has the formula—

$$\left.\begin{matrix}U_2O_3\\CuO\end{matrix}\right\}P_2O_5,8H_2O\ ;$$

and when dried at 100° C.—

$$\left.\begin{matrix}U_2O_3\\CuO\end{matrix}\right\}P_2O_5\ 2H_2O.$$

It does not lose water *in vacuo*.

The thanks of the Society having been given to the author by Dr. Odling,

A paper was read "*On the Action of Bromine on Protocatechuic Acid, Gallic Acid, and Tannin*," by J. Stenhouse, F.R.S. The author finds that, although at ordinary temperatures the action of excess of bromine on protocatechuic acid only produces mono-bromo-protocatechuic acid, $C_7H_5BrO_3$, yet at 100° carbonic anhydride is eliminated and tetra-bromo-pyrocatechin, $C_6H_2Br_4O_2$, is formed. Similarly, the action of bromine on gallic acid gives rise to dibromo-gallic acid at the ordinary temperature; whilst at 100°, with excess of bromine, this is decomposed, and tribromo-pyrogallol, $C_6H_3Br_3O_3$, is formed, with elimination of carbonic anhydride. This is the more remarkable, as neither proto-catechuic acid nor gallic acid are decomposed when heated alone to 100°. Commercial bromine and ordinary tannin, when heated to 100° with excess of bromine, likewise yield bromo-pyrogallol; the small amount of water naturally present in the materials being sufficient to convert the tannin into gallic acid, which is then further acted on by the bromine. The paper contains details of the best process for preparing protocatechuic acid.

The meeting was finally adjourned until Thursday, December 3rd, when there will be a communication "On the Formulæ of the Alums," by Mr. S. Lupton.

PHYSICAL SOCIETY.

Saturday, November 21st, 1874.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

At this meeting, held at the Science Schools, South Kensington, eight new members were elected.

Professor Macleod made a communication "*On a Simple Apparatus for Showing Internal Resistance in Battery Cells.*" Two tubes about half a metre long, and one of which is twice the diameter of the other, are closed at their lower ends with corks. On the corks, and within the tubes, rest two discs of platinum foil, connected with binding-screws by platinum wires passing through the corks. The platinum plates are covered with small quantities of chloride of silver, and the tubes are filled with a solution of chloride of zinc. Each tube is provided with a disc of amalgamated zinc soldered to a long copper wire, which is well covered by an insulating material. The discs are cut so that they nearly fit the tubes, one being exactly double the diameter of the other, and therefore exposing four times the surface to the action of the liquid. On connecting the terminals with a galvanometer, the current will be found to increase as the distance between the zinc and platinum plates is diminished by lowering the zinc plate in the tube. In order to obtain the same deflection of the galvanometer by the narrow cell, the distance between the plates must be one-fourth of the distance between those of the larger one.

The apparatus may also be used to show that opposed cells of the same kind will not produce a current. For this purpose, the platinum plates are connected together, and the two zinc plates joined to the galvanometer. No current will flow, whatever the distances between the plates.

A communication was also made to the Society by Mr. James B. Hamilton, "*On a New Class of Stringed Instruments*," of which he is the inventor, and in which the special advantages of the pianoforte and of the organ are combined.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 20th, 1874.

Edward Schunck, Ph.D., F.R.S., &c., President, in the Chair.

Mr. William H. Johnson, B.Sc., showed two remarkable pieces of iron cinder from a furnace in which iron is reheated. The samples showed on one side small dark prismatic crystals, which appeared to have been formed in a cavity of the cinder as it cooled in the cinder bogie. The reverse side of one of them had formed the wall of a second cavity; its surface was, however, smooth, black, shining, and studded all over with the sides of oblong jet-black crystals, unusually iridescent. He remarked that probably these crystals were fayalite, an iron chrysolite, a mineral found in the Mourne mountains in Ireland, which is sometimes iridescent, and whose chemical composition is represented by the formula Fe_2SiO_4. They are the more worthy of notice from the rare occurrence of crystals in mill-furnace cinder.

"*On a Colorimetric Method of Determining Iron in Waters*," by Mr. Thomas Carnelley, B.Sc. Communicated by Professor H. E. Roscoe, F.R.S.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Opening Meeting, November 9th, 1874.

Abstract of Address by the President, Mr. Edward C. C. Stanford, F.C.S.

The opening remarks were devoted to a notice of the life and scientific labours of the late Dr. Thomas Anderson, F.R.S.E., Professor of Chemistry in the University of Glasgow, and a former President of the Philosophical Society, and afterwards of the Chemical Section. Then, referring to the recent meeting of the Social Science Association in Glasgow, and to Dr. Lyon Playfair's presidency of the Health Section, Mr. Stanford said it is quite time that the aid of chemical research should be called in to give its assistance. It is remarkable how little we know, chemically, of the air we breathe, the soil we live upon, the water we drink, and the food we eat. The chemistry of hygiene is quite in its infancy. Pettenkofer avers that in all really healthy houses we virtually live out of doors, the walls being largely pervious to air; and he shows that, where these walls are saturated with water, they become impervious to air, and therefore unhealthy. It has been found that, to keep the air pure in houses, a ventilation is necessary of more than 2100 cubic feet per head per hour. When the model Hospital la Ribasière was erected in the Faubourg Poissonière, it was furnished with artificial ventilation; 700 cubic feet of air per head per hour was judged ample for all requirements. At this rate, the air in the wards was quite foul, and it was not until 2120 cubic feet were used that the hospital was pure. The rate now recommended is as follows:—

	Cubic feet per head per hour.
In hospitals for ordinary cases ..	2120 to 2470
" " wounded	3530
" " epidemics	5300

Pettenkofer shows that most of the ventilation of a room is through the walls, and we are apt to forget how extremely porous to gases these septa generally are. He reckons the average rate per square yard at about 7 cubic feet, or 43 gallons, per hour. He employs carbonic acid measurements in these researches, and the large wall ventilation shows that smaller houses have more ventilation, in proportion to their size, than large ones. In earth hovels, the ventilation is about double the average rate. Pettenkofer's researches generally are most interesting; and when we consider the number of disease germs often in the air, it must be confessed that our air chemistry is sadly at fault.

Turning to the soil we dwell on, we should not forget that our houses, if well drained, are practically built on air, or rather on soil full of air; and we know that, if this soil be full of water, our health suffers. The porosity of soil to air and gases is so remarkable, that Pettenkofer relates cases of "persons poisoned and killed by gas which had to travel for 20 feet under the street, and then through the foundations, cellar-vaults, and flooring of the ground-floor rooms." The porosity of the soil has an important effect on the decomposition of corpses. It has been shown that, in a porous soil, the body rapidly decays, whereas in a clay soil it is preserved for long periods. This shows the necessity for proper investigation before deciding on sites for cemeteries, unless we are to make our relations into gas, and thus "live by the light of our ancestors," as Dr. Lyon Playfair has suggested.

Turning to the water we drink, there is still, unfortunately, great difference of opinion as to the proper composition of good drinking water. The term "previous sewage contamination," which has been introduced, is misleading, because some of the deep well-waters will show large amounts of nitrates without a trace of organic matter; and it does not follow that these nitrates have been derived from sewage. On the other hand, the celebrated Loch Katrine water contains nearly as much organic matter as that of the best London supply, and there is no doubt that, to be entirely free from suspicion, this organic matter should be separated by filtration. Professor Wanklyn's method of water analysis has given great facilities for easily assessing the value of a drinking-water, and his manual on the subject should be in the hands of all analysts, for the analysis of drinking-waters is now constantly required. The amount of ignorance prevailing on this subject is extraordinary. It is impossible to convince healthy villagers that they have long been in the habit of drinking a dangerous water, and the analysts must always expect great opposition to his statements. In one case in Scotland, where a good water supply was voted against, one voter said that the engineer knew nothing about it, because he had got one 6-inch pipe to supply two 4-inch pipes, which was impossible; whilst another voter said the engineer could not have laid down the pipes right, because he had not measured the ground, forgetting that the ordnance map very accurately supplied him with the data. How can such people judge of the analysis of a water? The question of a water supply naturally leads to the consideration of that supply after our houses have fouled it into sewage. If we have only to deal with the water supply before and after it leaves our houses, we deal with a definite, fixed quantity, comparatively so small that it is easily dealt with. At present, however, the sewage of towns contains also that very variable item, the rainfall; and whenever that has to be included, it upsets all systems of filtration, irrigation, &c., because in time of floods it must be run to the nearest river. If the water-closet system is to be continued, it must be carried out in a separate system of impervious sewers; and, if anything is to be done with the sewage, that result must be attained before the assistance of chemists is called in. When the value of the material to be utilised is only one penny per ton, we must leave the towns to the tender mercies of the engineers. As for irrigation, farmers in the west of Scotland do not, as a rule, complain for want of water, and they would doubtless prefer their manure dry, certainly not in that extraordinary state of dilution which characterises the Glasgow sewage, which is only about two-thirds the average value. Bad as the river Clyde is, more processes have been brought before the authorities in Glasgow than anywhere else. Three of these are at present little known elsewhere, viz., Mr. Chapman's method of utilising the urine of the city, the Hoey "limited" water-closet system, and the carbon closet system, all of which have been reported upon by Dr. Wallace, F.R.S.E., F.C.S., to the Police Board of Glasgow. They are all processes of interception, and are all steps in advance, because they all utilise what has hitherto been waste and polluting material. Any method of keeping valuable, though polluting, matter out of the sewers ought to be encouraged, because, by so much, it lessens the difficulty. The question will probably resolve itself ultimately into this:—That all polluting material must be kept out of the sewers; manufacturers must look after their own pollutions, and householders after theirs, the town authorities looking after the rainfall and streets. Taken at the outlet, the question is extremely difficult; taken at the house, it is easy; and house-to-house purification may become the real solution of the difficulty.

Before leaving the subject of sewage, Mr. Stanford referred to that of disinfection, and said—The public appear to me to be altogether on the wrong track. Chloride of lime and carbolic acid are making our cities everywhere offensive. Both of these substances act well if concentrated; they act like the clean, sharp cut of the surgeon's knife, but they do not bear dilution. When dilute, both have been found actually to favour the growth of germs, and it cannot be too generally known that the universal use of these substances to overcome bad smells is simply substituting one stink for another. There is nothing more difficult than the purification of infected air. A good disinfectant should not itself foul the air it pretends to purify. The only true way to disinfect is to prevent decomposition. We have several old antiseptics that ought not to be forgotten. Dr. Angus Smith has shown that common salt is much cheaper and better than these popular and odoriferous remedies. I have strongly urged the use of chloride of calcium for this purpose—it is the cheapest of all disinfectants, and can be got in enormous quantities.

The food question leads us to the consideration of the Adulteration of Food Act. This has given rise to a large number of appointments to chemists as local analysts. Unfortunately, our science has not hitherto come well out of the sudden demand made on it. In the first place, the appointments were so numerous that we had not the men, and there is no doubt that our processes for the detection of adulterations in food were very crude and immature. These, however, are merely temporary difficulties, as Wanklyn's series of food researches has shown that milk, tea, coffee, and cocoa can be accurately tested. But these are only a small portion of what comes under the public analyst's attention. The position not only requires high analytical ability, but likewise a large knowledge of the trades in food products, &c. Speaking of commercial analysis, Mr. Stanford said:—"The great discrepancies between 'different analysts which have given rise to the very objectionable titles of 'high' and 'low' chemists, have been a scandal to our science." With a view of making some reform, we agreed to petition the British Association to appoint a Committee to inquire into the methods of testing potash, salts, and phosphates—those being the substances in which we had noticed the greatest variation—and if possible arrive at standard processes of general application, and agree as to statements of analytical results. The Newcastle Chemical Society supported us in our application; and they added copper, soda, and sulphur. As showing how strongly the chemists felt in that large centre of manufacturing chemistry, they also passed the following resolution:—"And that this Society is of opinion that the sub-committee suggested might also usefully inquire into the question of instituting a professional examination for a diploma, without which no person should be legally qualified as a public analyst." This resolution was soon after given effect to in a meeting of public analysts, held in London, under the presidency of Dr. Redwood, and where resolutions were passed almost identical. These chemists had been roused to action by the suggestion to the Committee on Adulteration that the Inland Revenue Laboratory should be the ultimate court of appeal in disputed cases. The Adulteration of Food Act has done much good, and when it is regulated, as it will be, by the analyses of accomplished chemists, working by accurate chemical processes, and not by microscopic medical men, it will be a great boon to the nation. The British Association appointed a committee, with a grant of £10, to meet our wishes, and inquire into potash salts and superphosphates. It consists of Messrs. Dewar, Fletcher, Allen, and Stanford, with power to add to their number, and Mr. Allen as secretary.

Referring to the progress of original research in chemical science, Mr. Stanford noticed the artificial production of vanillin, and proceeded to say—The Society of Germany Ultramarine Manufacturers have offered a prize of one thousand imperial marks for the best work on the constitution of ultramarine, and the exact form of combination in which the sulphur exists. If any of our members think of taking up this research, I would point out that many of the sulphur compounds with alkalies are undefined. No perfect explanation has yet been given of the curious colour changes in the evaporation of caustic soda from dark red to green and blue, before actual fluxing. I would also remind those who want "something to tussle with," that artificial quinine is yet undiscovered. We know very little about the real causes of nitrification. I have shown that neither charcoal nor earth oxidises ordinary nitrogenous organic matter, and that the latter simply produces decay and evolution of ammonia. In solution, the action of various filtering media on nitrogenous organic matter is very imperfectly understood. This much may in the meantime be said on the subject, namely, that filtration through porous bodies tends to convert the nitrogen into ammonia rather than, as is generally supposed, into nitric acid. Those engaged in the manufacture of chemicals have enough to do now to hold their own against foreign competition. Where elaborate chemical processes are required, as, for instance, in the preparation of the natural alkaloids, we cannot compete with the German manufacturers, who, with the exception of quinine and morphia, have this class of manufacture mostly in their own hands. We cannot secure sufficiently educated workmen for this high class of work. One of the most important contributions from the laboratory to medical science is chloral hydrate, the first narcotic artificially produced. This substance, for which there is now an enormous demand in medicine, is almost all imported. Our manufactures in this and in the alkaloids are also handicapped by the large duty payable on alcohol in this country. We can obtain methylated spirit free of duty for manufacturing purposes, but unfortunately this is an impure spirit, and unsuitable for the preparation of pure chemicals. As the use of this spirit entitles the excise officer to visit the works, it would be well to allow the use of pure spirit in all chemical works under certain restrictions.

Mr. Stanford next referred to the manufacture and large consumption of bromide of potassium in medicine, the large imports from the German potash mines, the extraction of iodine from the nitrate of soda liquors of Chili, the importance of potash in agriculture, and then enlarged upon recent attempts to improve upon Le Blanc's process for the manufacture of carbonate of soda. The most promising improvement, he said, is that of Hargreaves and Robinson, who decompose the chloride of sodium direct by sulphurous acid from the pyrites burners. They thus do away with the wear and tear of vitriol chambers, and produce sulphate of a high degree of purity. Large works are being erected in Lancashire for this process. One of the new improvements in manufactures that appear to me very valuable is Morfit's method of making soaps direct from the combination of the fatty acid with the carbonated alkali, thus making a soap direct without the expense of causticising the alkali, and the prolonged boiling necessary to decompose the oil or fat employed, and the loss of the whole of the glycerine. In our alkali manufactures many improvements have been introduced. One of the most notable, perhaps, is the revolving black-ash furnace, which economises labour. Labour and fuel are very important elements in the manufacture of soda-ash, the raw material being low in value. In potash working the waste is the most important consideration, the raw material being expensive. The utilisation of waste is still the most important of chemical questions. Weldon's process of manganese recovery, and Mond's process of extraction of sulphur are valuable steps in the right direction, and each can be worked with a profit; but they are only steps, and neither can yet be considered perfect. I cannot leave this question without referring to the process of one of our members, Mr. Mactear, which appears to me a great improvement, and is now at work at St. Rollox. He employs the sulphurous acid gas from pyrites for the oxidation of the yellow liquors, which are then decomposed by muriatic acid—thus obtaining both the sulphur of the waste, and that of the pyrites. Mr. Mactear is enabled also to take advantage of the natural rainfall, and simply use the liquor draining from the very large stock of waste which Messrs. Tennant and Co. have in reserve. Manufacturers may expect next year an amendment of the Alkali Act. I do not know if the 5 per cent allowance of hydrochloric acid escaping will be reduced, but I think it ought to be. Half this would appear to me not unreasonable. Certainly sulphurous acid will be included in the new law, and it ought to be, for I am convinced from personal observation that sulphurous acid is more destructive to crops than hydrochloric acid. Under the new laws we shall have to be more and more particular in our chimney testing. It is unfortunate that although we can easily determine the gases in a cubic foot of the air passing out of our chimneys, it is exceedingly difficult to ascertain exactly how many cubic feet pass per minute. I have tried every apparatus yet introduced, but none appear to me quite trustworthy and satisfactory in working on such a variable rate as that of a chimney.

Mr. Stanford then briefly described the testing apparatus used in his own works, and concluded by referring to the Technical College movement, and the prospect of a better class of workmen being provided.

CORRESPONDENCE.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

Sir,—I regret to find that an erroneous *datum*—the specific gravity of oxygen (which, in absence from my library I took from a borrowed treatise on chemistry apparently faithful)—should have led to so great an encroachment on your columns. It must be regarded only as an unlucky misprint; and I am much obliged to your three correspondents for their correction of the error, the more so as it has enabled me to prove that the expansion of the volume due to the conversion of CO_2 into CO is perfectly compensated by the contraction of volume consequent on the combustion of CO, the result (of importance to me) being that heat is neither lost nor gained. Perhaps I may be excused for my oversight when I find that each of the three gentlemen gives a different number, while a fourth gives me another number differing from the rest, though all agree up to the first decimal place.

Addressing myself principally to Mr. Routledge's letter, I must say that it is new to me to hear it said "that mathematicians are happy only in applying the deductive methods of their science, and careless about the verification of their data." I have always believed, and I hope with good reason, that a training in the exact methods of the physical sciences leads to habits of the widest and strictest induction of facts, as well as to deductive accuracy; and I think that the philosophy of chemistry would not be the loser if its professors generally had such a training.

Mr. Routledge has altogether misconceived the object of the algebraical statement which he criticises. That object was to apply a test, a *reductio ad absurdum*, to the statement "that the volume of the CO generated by the conversion of CO_2 by union with C is double of the aggregate volumes of CO_2 and C." This I had to combat, and I have done so successfully, for the ratio of the volumes is that of 3 to 4, even as shown by the molecular-volume notation. Thus, taking $CO_2+C=2CO$, the ratio is—

$$\begin{aligned} &1 \text{ mol. } CO_2+\tfrac{1}{2} \text{ mol. } C : 2 \text{ mols. } CO \\ =&2 \text{ mols. } CO_2+1 \text{ mol. } C : 4 \text{ mols. } CO \\ =&4 \text{ vols. } CO_2+2 \text{ vols. } C : 8 \text{ vol. } CO \\ =&2 \text{ vols. } CO_2+1 \text{ vol. } C : 4 \text{ vol. } CO \\ =&3 : 4 = 1 : 1\tfrac{1}{3}, \end{aligned}$$

being an *expansion* of $\tfrac{1}{3}$ on 1, as I have determined by my formulæ with the now-corrected value of the density of oxygen.

If we take $CO+O=CO_2$, we obtain, similarly, the ratio 2 vols. CO + 1 vol. O : 2 vols. CO_2, or as $3 : 2 = 1 : \tfrac{2}{3}$, being a *contraction* of $\tfrac{1}{3}$ on 1.

As Mr. Routledge is so unsparing a critic, it is not unfair to ask whether he is always able to use correctly his own tools? He brings out the density of carbon vapour as 0·414, saying that, "when the equation is written in accordance with the statement that 1 vol. of CO_2 added to (combined with) 1 vol. of carbon vapour forms 2 vols. of CO, the solution gives $x=0{\cdot}414$." Now, this is only *half* the correct number, 0·828. The statement should have been, 1 vol. $CO_2+\tfrac{1}{2}$ vol. C. forms 2 vols. of CO, the molecular formula of carbon being C_2, not C.

The other two wrong statements made to me remain uncorrected, but, as I have now corrected them for myself, I need not dwell upon them here.

Some years ago, the most eminent astronomer and mathematician in Europe, and withal a capital chemist, long my kind patron and counsellor, asked me "Why I used that detestable chemical notation, and not the true algebraical?" I answered, that "I used it only to sum up or enunciate results obtained, and this in deference to the convention among chemists; but that I always *worked* with the algebraical." I take occasion to press this matter on the serious attention of chemists. They are using *two* signs for addition, or combination, or union—one, juxtaposition (the sign of multiplication), the other (+) the proper sign. They are using, also, the symbol of "powers" to express numerical multiples; but, worst of all, they too often use = where no numerical equality exists, to express "produce" or "result from." I have used above the simple sign of ratio (:); this is all-sufficient, as well as unequivocal, and, as it comprises equality in the rorm of 1 : 1, is perfectly general, and I recommend it to chemists for adoption accordingly.

When I said that the equations—

$$A+B=C \quad \text{and} \quad \frac{A}{a}+\frac{B}{b}=\frac{C}{c}$$

could not co-exist unless—

$$c=\frac{A+B}{\dfrac{A}{a}+\dfrac{B}{b}},$$

I merely affirmed what is indisputably a general truth, whatever A, B, C, a, b, c, might be, so long as = signifies "numerically equal." But, of course, if = signifies "produces" or "results from," there is no more to be said, except that such an equivocal symbol should have no place in a science.

Let A be carbonic oxide, B oxygen, $a=0{\cdot}9706$, $b=1{\cdot}106$, then c should be $=1{\cdot}520$, if the equation between the volumes co-exist with that between the weights; but it comes out $=1{\cdot}016$. The volumes, therefore, cannot be equal, though the weights are equal. The explanation can only be that either the sign = has another signification, or the term volume has. Now, we know that, as $CO+O=CO_2$, the true ratio is—

$$1 \text{ mol. } CO+\tfrac{1}{2} \text{ mol. } O : 1 \text{ mol. } CO_2,$$

or—

$$2 \text{ vols. } CO+1 \text{ vol. } O : 2 \text{ vols. } CO_2;$$

that is, as 3 : 2, so that the above equality cannot exist. The numerical relation, then, between the weights, and that between the volumes, in this case are not identical.

I venture to suggest that it would be more fruitful of results, as well as more philosophical, to compare, in all cases, the sum of the volumes of the components with that of the compound (as we now compare their weights), placing (:), the sign of ratio, between them. If we are ever to express the specific gravity of a compound in a function of the specific gravities of its components, *all* of the latter must be included.

Mr. Routledge, in referring to the vapour of carbon, uses the term "imaginary gases." I only wish we were half as sure of the reality of "atoms" and "molecules," and knew as much about them and their mysterious agencies!

This "carbon vapour," it is assumed, cannot be exhibited in a separate state, though I would not venture to affirm that, with a high temperature *in vacuo*, this could not be done (the spectroscope would soon settle this point, if it has not already done so); but carbonic oxide, carbonic acid, cyanogen, and the two forms of carburetted hydrogen, are all homogeneous, transparent, elastic fluids, possessing all the mechanical and physical properties of the simple gases. Carbonic acid, like the vapour of water, can be condensed by cold and pressure into a fluid medium, and frozen afterwards into a solid. In the diamond, carbon is transparent, though infinitely hard and incompressible, while ice is sensibly elastic. Water is slightly compressible, and transmits a feeble sound, though composed of highly-elastic gases. The fair inference from analogy is, that carbon is capable of vaporisation, as are iodine, bromine, sulphur, mercury, &c.; indeed, it is almost inconceivable that a gaseous body should have non-gaseous particles diffused among its mass, while the mass itself is homogeneous, as its action on light proves it to be. The densest of metals can be vapourised; then why not carbon?

Returning from this digression, which was scarcely avoidable, to the object of my original communication to your journal, I wish it to be understood that I did not profess to make any chemical discovery. I had conceived that, in the symbolical methods of chemists, there lurked either fallacy or ambiguity of signs, tending to mislead, and to lead to inaccurate conclusions. Whether I have been right in my impression, or how far my views of the matter are justified, I leave it to the candour of you and of your readers to decide.—I am, &c.,

F. C. Knowles.

Mayfield, near Ryde,
Nov. 17, 1874.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

Sir,—I have read with some interest the communications of Mr. Robert Frazer Smith "On the Presence of Ferrous Sulphide in Char," published in late numbers of the Chemical News, and also the criticisms they have evoked from Messrs. Speir and Stewart. It is somewhat refreshing to note the ardour with which many young chemists dilate upon some facts that come under their observations, and are deemed by them *discoveries*, or tantamount thereto. Bone char has of late been a happy source of such ambitious results in the hands of a few of the class indicated. I remember a critical analyst of the order furnished your readers some time ago with a *resume*, intending to prove that "char" always contained variable amounts of *organic matter*, amounting sometimes to 5 per cent. The current question of the existence of ferrous sulphide in char bears, I think, a close relation to the preceding alleged *discovery*.

Whilst I admire the zeal manifested by these men in *publishing* their results, I cannot help entertaining a slight disapproval of the language they use, whereby they depress the labours of other chemists to a lower level than that they fancy they have attained. Thus, Mr. Smith asserts—"All chemists usually state the total sulphur in char as calcic sulphate," a statement that is not generally correct, as I will show. I do not know how many other chemists besides myself recognised the fact; but, while engaged in writing the article, "Animal Charcoal," for the late Dr. Muspratt's "Chemistry, as Applied to the Arts and Manufactures," in 1852, I devoted considerable time to the examination of "chars," and then ascertained that all chars, *new* as well as old, contained sulphides. After numerous analyses, as critically exact as I could make them, I came to the conclusion that the sulphide in every instance existed as calcic sulphide. I have never found that the iron dissolved on treatment of the char with dilute HCl rose to the proportion necessary to constitute ferrous sulphide, with the H_2S eliminated; on the contrary, that the calcium exactly fitted the groove. Hence my conclusion to adopt calcic sulphide as the expression of the combination of the sulphur present as sulphide. From that time, whenever I have had occasion to make a complete analysis of "char," I have recorded this constituent among my results, deducing it from the determination of the H_2S evolved.

Unhappily, I cannot refer to particulars of those analyses, because the College Records containing them, and many others of my humble labours down to 1871, are in the hands of the executors of the late Dr. Muspratt, and I cannot get to refer to them; but, since the beginning of 1871, I can cite numerous examples in proof of the preceding statement. The following may be accepted as representative examples; they are copied from Record Book A, pp. 359 and 393, of the dates November 29 and December 28, 1871, respectively:—

ANALYSES OF CHARS.

	Date of Analyses, Nov. 29, 1871.		Date of Analyses, Dec. 28, 1871.		
	Sugar Char.	Treacle Char.	Char No. 1.	Char No. 2.	Char No. 3. Dust.
Carbon	8·841	8·960	10·363	10·814	12·161
Earthy phosphates ..	78·872	84·920	80·091	82·275	78·128
Carbonate of lime ..	2·680	0·906	4·753	2·706	5·081
Sulphate of lime ..	0·281	0·180	0·304	0·473	0·331
Sulphide of calcium	0·773	1·134	0·468	0·383	0·352
Alkaline salts	0·291	0·241	0·149	0·183	0·169
Soluble iron oxide ..	0·206	0·528	0·462*	0·306	0·471
Insoluble matters, composed of silica and iron silicate ..	1·764	1·353	1·642†	1·527	1·505
Moisture	6·652	1·773	1·768	1·533	1·802
	100·000	100·000	100·000	100·000	100·000

* The marginal expression of these numbers is "oxide of iron soluble in strong mineral acids."

† Defined as "insoluble matters, consisting of sand and oxide of iron.

I could furnish you, Sir, with similar copies of analyses of chars made by me since the above dates, sufficient to fill several numbers of the Chemical News, were it necessary. In common fairness to Mr. Smith, and the expression already disapproved, I feel it incumbent on me to state that, in all the analyses of "chars" by other chemists which I have seen, I have not observed a single instance in which *sulphide* of any kind is tabulated among the constituents, excepting some modern ones by Dr. Wallace. Previous to 1873, however, he made no record of sulphide in his results—and I have seen several of his certificates—so far as I can ascertain at present.

I think (perhaps wrongly) I was indirectly concerned in determining the Doctor's attention to this component of "char;" for, towards the end of 1872, certain of my patrons here submitted some analyses of mine to the Greenock folk in the sugar trade, among whom Dr. Wallace commands a large practice. Whether my tabulation came under his eye or not, I cannot say; yet I cannot avoid regarding the coincidence as curious, that in all his results of chars made in 1873 he gives calcic sulphide as a constituent.

I point to these facts with the view of liberalising Messrs. Speir and Stewart's views, as rendered in Chemical News, pp. 225 and 226. Respecting the extract from Dr. Wallace's letter given by Mr. Speir, I may remark that I made some elaborate analyses of chars for Messrs. Blair, Reid, and Steele, and furnished the firm with a lengthy "report" respecting them on the 26th of February, 1874; in these analyses, the amounts of calcic sulphide present were stated. It would be curious should my communication be withheld from Messrs. Smith and Speir, seeing they were chemists in the establishment at the time, and, doubtless, much interested in the solution of the enquiry then on foot.

However, Dr. Wallace certainly recorded calcic sulphide in char up to nearly the end of 1873; but since that time he may have educed reasons for changing his view.

I have seen no results of the Doctor's establishing the ferrous sulphide as the component, and I do not think Mr. Smith's experiments confirm its existence. When tangible proofs appear, I will be very ready to forego my long-entertained conclusions of the constitution of the sulphide; but, till these are produced, I am forced, by the circumstances already stated, to adhere to calcic sulphide.—I am, &c.,

Martin Murphy.

The Liverpool College of Chemistry,
November 17, 1874.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—My attention has been called to a long and good-humoured letter from a gentleman with the initials T. A. R., in the Chemical News of this day, and if I do not follow him into the details he invites me, it is certainly not from any desire to avoid touching pitch, or even T. A. R. himself, but because to defend the names assigned to the minerals in any collection or book is to defend a cause that is essentially a bad one.

Mr. Dana, in his last (1868) edition, has taken a great deal of trouble, and that in a thoroughly scholarly way, to arrive at the earliest names by which minerals were distinguished by their discoverers. And he has accordingly, in adopting these names, necessarily complicated the nomenclature of the science.

Responsible not only to Englishmen, but to the whole scientific world, for whom this collection is becoming a sort of Metropolitan collection, I have shrunk from the extensive changes in nomenclature that the adoption of Dana's names would involve.

I have changed a few names where ambiguity was associated with the old ones; otherwise I have adopted and held to such names as either my experience led me to think were associated in the minds of the greatest number of mineralogists with the particular minerals, or, in cases in which this might be doubtful, I have adopted names that either from their expressiveness, or from some other reason, appeared to me to be on the whole the best. The case of hemimorphite, for example, is one quite to the point, as I doubt not T. A. R. will see without words of mine. I don't suppose T. A. R. has really any difficulty in recognising the combination of zinc hydrate with zinc silicate under the name of hermimorphite at least as well as under the names of smithsonite or of calamine. He has let his pen slip among these names in his letter, very naturally, considering the confusion that has attended their use. Here, as in the case of chalybite, I have made the smallest necessary change.

For *groups* like those of the felsparr, the chlorites, and micas, I have retained for the present group names. Few mineralogists could be misled by this.

As regards T. A. R.'s requirement that this museum should contain every substance to which vanity or ignorance has given names, as well as those which have a place in scientific mineralogy, I only accept his judgment in respect to the latter class of minerals, and of these I trust he and others will find that wherever such rare minerals as are not here can be obtained, the museum will be among the first in the field to obtain them. But it is to be remembered that several of them are not to be obtained at all.—I am, &c.,

Nevil Story Maskelyne.

Mineral Department, British Museum,
Nov. 20th, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 16, October 19, 1874.

Dissociation of Hydrated Salts.—M. H. Debray.—The author complains that M. G. Wiedemann, in a recently published paper on the dissociation of the hydrated sulphates of the magnesium metals (*Poggendorff's Annalen*, jubelband, p. 474, 1874), has arrived at conclusions similar to his own, bearing date 1868, and has published them without any reference to the latter.

Magnetic Condensation in Soft Iron.—M. A. Lallemand.—The magnetic condensation first observed and studied by M. Jamin in steel, occurs also in soft iron with a very remarkable intensity and persistence. A horseshoe electro-magnet is formed by a cylinder of iron, 4 centimetres in diameter, each limb of which is surrounded with a coil of wire of 2 m.m. in diameter, and 150 m.m. in length. The armature is a blade of soft iron 2 c.m. in thickness, and 4 in width. When the double coil is traversed by the current of a single Bunsen element, feebly charged, the keeper is able to support about 150 kilos. On interrupting the current the keeper remains strongly adhesive, a fact already often observed. It can support as much as 50 kilos. without detaching itself, but after this rupture every trace of magnetism disappears, and the electro-magnet is not even able to support the keeper. We might suppose that cohesion might be partly concerned in the adherence of the armature after the cessation of the current; but this is not the case, since no cohesion is manifested even under a greater pressure than that caused by magnetisation. Moreover, a magnetic needle placed in the vicinity of one of the polar surfaces shows a marked deviation, which disappears as soon as the keeper has been torn away. But what is particularly worthy of notice is the persistence of this magnetic condensation. An electro-magnet has been left for twenty days, and at the end of this time the keeper still supported 50 kilos. without becoming detached.

Hypothesis on the Imponderable Ether, and on the Origin of Matter.—M. Martha-Beker.—The ether is recognised and considered as a diffusive, subtile, imponderable substance, filling up not merely all the spaces of the universe, but all the interstices, which isolate the atoms one from another, so that every impulse communicated to this subtile indefinite ocean is propagated amidst these infinitely small spaces, producing there the molecular motion which animates the depths of the constitution of matter, just as gravitation animates the depths of the sidereal world. The agitation communicated to the ether by the various luminous, thermic, electric, magnetic foci, secondary dynamic centres, transmits their rays by means of indefinite and successive currents of waves, and produces the fluids, properly so-called. Others seem to represent the dynamic manifestations which would emanate from a virtual focus, the centre of gravity, and of impulsion of the world, the prime motor of which would be distinct, conscious, and immaterial, as the universal harmony supposes and demonstrates. This virtual focus would impress upon the ether agitations variable in intensity and in direction, but obedient to the law of harmony, and of the final cause. These would be not merely parallel and successive waves, like those proceeding from the secondary foci, but series of waves of various powers, intersecting each other in points determined by the general plan of the universe. At the intersecting points of these waves will be formed veritable nodes, participating at once in the ethereal and in the dynamic nature, *i.e.*, atoms having an extension, or a real form, and a determinable atomic weight, the imponderable having been compressed so as to become ponderable. The nodes of waves of the same species, of the same amplitude or intensity, will engender like atoms; and as this will be most generally the case, there will result the most expanded, and the lightest simple element—hydrogen. If the two waves which cross each other have not the same amplitude and the same intensity, they will yield atoms of the same form as those of hydrogen, but they will not have the same weight, the same atomicity which will permit of substitution in their ulterior combinations without the structure of these combinations being altered. When, on the contrary, a node becomes the centre, if entanglement of more than two waves, there will arise atoms different in form and weight. The weights will increase in simple proportions, in relation to the number and the normal disposition of the waves which have concurred in the formation of the node. The first atom having been formed, and the movement continuing under the same conditions, there will ensue a successive accumulation of like atoms, which will group themselves into molecules floating in the ether, and which will gradually form the cosmic matter of the unresolvable nebulæ. The several groups of these formations will tend to concentrate themselves, and ultimately to coalesce into stellar agglomerations, there where the greatest mass of waves shall meet. These great concentric foci will arrange themselves in immense orbits, as the laws of astronomy reveal, carrying with them their train of secondary foci. Can matter thus formed annihilate itself again and disappear in the ethereal ocean, returning by inverse phases to its starting-point? To resume; by its various modes of vibration, indefinitely transmitted and susceptible of acquiring special properties, and a real palpable condition at the points where it concentrates itself in groups, the ether may not only give rise to imponderable fluids, but even to atoms themselves, and to the molecules of all the elements of ponderable matter.

Distribution of Sugar and of Mineral Principles in Beet-root.—M. Ch. Violette.—Contrary to the opinion hitherto received, the sacchariferous and cellular tissues of the beet root contain proportions of sugar differing but little. The sugar increases very sensibly in an arithmetical progression, following the axis of the root from the neck to the point. The total mineral matters do not experience a regular variation, but chlorides are more abundant at the neck than at the extremity. The proportion of mineral matter is greater in the cellular than in the sacchariferous tissue, the relative amount of chlorides being three to eight times larger.

Experiments on the Circular Compass, made on Board the "Faon" and the "Savoie."—M. E. Duchemin.—The observers consider the circular compass preferable to the needle, both in fine weather and in storms. It has the advantage both in stability and sensibility.

Remarks on the Recent Papers of MM. Signoret and Lichtenstein on the Known Species of the Genus Phylloxera.—M. Balbiani.

Observations Relative to a Recent Note, by M. Rommier, "On Experiments made at Montpellier on Phylloxerised Vines with Coal-Tar."—M. Balbiani.

Influence of Temperature on the Development of the Phylloxera.—M. Maurice Girard.

Observations Respecting a Paper on Supersaturation by M. Lecoq de Boisbaudran.—M. D. Gernez.—M. Gernez defends his claims to originality, or rather to novelty, which M. Lecoq de Boisbaudran had called in question.

Researches on the Decomposition of Certain Salts by Water.—M. A. Ditte.—The salt in question is the sulphate of mercury. In contact with water at common temperatures the sulphate of binoxide of mercury becomes instantly discoloured. Sub-sulphate is precipitated, and the water becomes strongly acid. The reaction continues on adding the neutral salt, until the amount of sulphuric acid set free reaches a certain limit. From that point the liquid decomposes no more of the salt, but simply dissolves the sulphate till it is saturated. The minimum quantity of free acid which a liquid must contain in order not to decompose the salt, increases as the temperature rises. Hence a clear solution of mercuric sulphate in water, containing 67 grms. of free acid per litre, becomes turbid when heated. The presence of another acid in the liquid does not affect the phenomena.

Absence of Iron in the Colouring Matter of Blood. MM. C. Paquelin and L. Jolly.—The authors have formerly shown that iron exists in the blood globule in the state of tribasic phosphate of protoxide, and that hæmatosin contains no iron. The second conclusion was formed from the fact that maceration of blood globules in ammoniacal alcohol, submitted to a series of filtrations and distillations, yields an impure hæmatosin, which becomes poorer in iron after every operation, and contains no longer a trace after the fourth treatment. Pure hæmatosin presents the following properties:—It burns, leaving no ash, like resinous bodies; it is insoluble in pure water; it dissolves sparingly in ammoniacal water, giving it a pale yellow colour. It is affected by caustic potash and soda, to which it gives a brown tinge; alcohol dissolves it sparingly, taking an amber colour. Its solvents are ether, chloroform, benzol, and sulphide of carbon. The dilute solutions are yellow, and the concentrated red. The authors announce their intention of giving the elementary composition of hæmatosin in a future paper.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 5, 1874.

Mineralogical Communications.—G. vom Rath.—These communications consist of a contribution to our knowledge of the crystallisation and twin formations of tridymite; description of a remarkable crystal of calcareous spar from Lake Superior, *apropos* of which the author points out that a monograph of the modifications of calcareous spar would be a boon to mineralogists; a peculiar specimen of rutil and iron-glance grown together; remarkable crystals of artificial metallic copper; the discovery of hypersthene in a trachytic rock, *Rocher du Capucin*, near the baths of Mont Dore in Auvergne; and foresite, a new mineral of the zeolite family, from the granite veins of Elba. Foresite consists of—

Silica	49·96
Alumina	27·40
Lime	5·47
Magnesia	0·40
Potash	0·77
Soda	1·38
Water	15·07
	100·45

It is most nearly connected with desmin.

Direct and Indirect Determination of the Poles of Magnets.—Th. Petruschevsky.—A long and illustrated paper, not adapted for abstraction.

Law of the Development and Grouping of Crystalline Zones.—Dr. G. Junghanns.—Not adapted for abstraction.

Resistance of the Air to Plane Discs, moved in a Normal Direction against their Planes.—G. Hagen.

Mechanical Principle proceeding from the Hamiltonian Theory of Motion.—J. J. Müller.

Previous Thermostats, and on a New Arrangement. H. Laspeyres.—The author points out the importance of being able to maintain for a length of time a perfectly constant temperature, and shows the disadvantages and imperfections of all apparatus hitherto devised for this purpose. His own thermostat is simple, trustworthy, and convenient. It permits of the maintenance for weeks—or so long as the required flame is kept up—of any given temperature between + 35° and 325°. For a bath he recommends sulphuric acid, which when undiluted boils at 325°, and by proper dilution with water gives every temperature down to 100°. For lower temperatures mixtures of absolute alcohol and water assist us down to 78·4°, and by mixtures of absolute alcohol and anhydrous ether we reach 34·9°. Any apparatus in which these four liquids or their mixtures can be boiled without change is a thermostat. It is essential, therefore, that all the vapour given off should be condensed and returned to the liquid. The apparatus may consist of glass. As the boiling vessel we may use a strait-sided Erlenmayer's flask, made of thin well annealed glass, and with as wide a neck as possible. It is closed above with a stopper of cork, or of caoutchouc, according to the temperature. As long as no acid vapours are given off cork is not attacked, if spitting can be avoided. In the stopper are two apertures about 5 m.m. in width for the condensation tube, and an opening as wide as possible to receive a test-tube, in which are placed the substances to be heated, along with a thermometer. The condensation-tubes are about 15 m.m. in width, and 20 to 25 c.m. in length. If the apparatus is required to be on a larger scale, it may be made of copper lined with sheet platinum, which must not fit too tightly.

Crystalline Form and the Modifications of Selenium.—C. Rammelsberg.—The author, differing from Mitscherlich, finds that sulphur and selenium are isomorphous, a view confirmed by the examination of the sulphide of selenium. Selenium appears in four modifications:—

1. Amorphous.	Sp. gr.	4·3	Red, soluble.
2. Crystalline.	"	4·5	" "
3. Granular.	"	4·4—4·5	Grey, insoluble.
4. Foliaceous.	"	4·8	Nearly black, insoluble.

At 90° C. Nos. 1 and 2 are converted into No. 3. By fusion and rapid cooling Nos. 2, 3, and 4 pass into 1, but by slow cooling into 3. All the modifications are permanent. As the granular and foliaceous forms of selenium are evidently crystalline, it must be regarded as tri-morphous. None of the modifications of sulphur assume, like the grey form of selenium, the physical characters of a metal, *i.e.*, the power of conducting heat and electricity.

Transformation of the Vibroscope into a Tonometer, and on its Use to Determine the Absolute Number of Vibrations.—A. Terquem.

Simple Apparatus for the Production of Ozone by means of Electricity of High Tension.—Prof. A. W. Wright.—Extracted from the *Am. Journ. Sci.*, series III., vol. iv., p. 26.

Spectroscope with a Fluorescent Eye-piece.—J. L. Soret.—(*Arch. des Sciences Physique*, April, 1874.) Two methods have been applied for observing the ultra-violet portion of the spectrum. In the one it is photographed. The prepared plate is introduced in an ordinary spectroscope, there where the thread-cross of the telescope is in general to be found. An extremely delicate image of the spectrum is thus obtained, and, with some experience, it is possible to measure the deviation of the lines accurately. But, upon the whole, the operation must be pronounced tedious and complicated. In the second method the spectrum is thrown upon a fluorescent substance, when the ultra-violet portion becomes visible. But the observation must be made in a totally dark room, and is ill adapted for the measurement of angles. The procedure here recommended, a modification of the second method, consists in placing a plate of some transparent and fluorescent substance in the telescope of the spectroscope at the focus of the object-glass, and in examining the spectrum with an eye-piece inclined towards the axis of the telescope. We pass over the detailed description of the apparatus, as unintelligible without an illustration, and proceed to the author's account of his experiments. With uraniferous glass the fluorescent spectrum is very visible from the line G. It is very intense towards H; the four stripes, M, are also visible, but beyond it is less distinct. With bisulphate of quinine the spectrum is very beautiful and brighter. It extends but little into the visible portion, about to *h*. The lines are very distinct as far as the group N, and even a little beyond. Æsculin, slightly concentrated, seemed to give the most intense spectrum. The line N, and even O, can be clearly distinguished. The spectrum extends into the violet, somewhat farther than quinine. Magdala red (naphthalin) somewhat concentrated, gives inferior results for the ultra-violet portion beyond M. The appearance of the fluorescent spectrum in the part corresponding to the directly visible rays is peculiar. Almost from D to M all lines are perfectly distinct. The appearance presented depends not alone on the fluorescent substance and its degree of concentration, but also on other circumstances. The intensity of the sunlight has a great influence. If the sky is not clear, or the sun near setting, the spectrum loses much of its intensily. The nature of the prism is also important. With one, and even with two prisms of white flint glass there is seen a great extent of the ultra-violet spectrum, especially when the bundle of rays passes close to the edge of the prism. Heavy flint glass, as is well known, absorbs the ultra-violet rays. The same occurs with the system of prisms in direct-vision spectroscopes. A more extended spectrum could doubtless be obtained with prisms and lenses of quartz or of calc-spar. As regards the application of this procedure to the study of the ultra-violet spectra of metals, the results obtained have not been quite satisfactory.

Conversion of Ordinary Phosphorus into the Amorphous State by the Action of Electricity.—Professor v. Schrötter.—In these experiments Dr. Geissler uses an exhausted glass tube 35 centimetres long, 2 centimetres wide, into the ends of which the conducting wires are fused in additional pieces, so that their extremities are at least 45 centimetres apart from each other. The tube was filled with phosphorus-vapour of low tension. After the experiment the sides of the tube were lined with a thin layer of amorphous phosphorus, varying in colour from reddish brown to a golden yellow.

Spectra of Lightning.—Th. Hoh.—During a thunderstorm at Bamberg, April 23, the author observed the spectra of several flashes. He counted two or three lines in the red; one each in the yellow and orange; three to four in the green; and one in the violet. On occasion of a very brilliant flash he distinguished a group of five lines in the blue.

NOTES AND QUERIES.

Alumina.—Can any of your correspondents tell me the best precipitant for alumina from an acid solution, on a large scale? Also the best method of filtering?—Alumina.

Estimation of Organic Bodies.—Could any of your numerous readers inform me of any book containing articles on the quantitative estimation of the following substances:—Aniline, anthracen, mineral oils, sugar, and charcoal?—R. S.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphate of soda and sulphate of potash, and in apparatus used in the said manufacture. William Hunt, manufacturing chemist, Castleford, near Normanton, York. March 6, 1874.—No. 831. This invention refers to the manufacture of sulphate of soda and sulphate of potash by the action on chloride of sodium and chloride of potassium of a mixture of sulphurous acid gas, steam, and atmospheric air. According to this invention the gaseous mixture or current is passed through the chambers containing the chloride in an alternately upward and downward direction; that is, the current passes downwards in the first chamber, upwards in the second chamber, downwards in the third chamber, and so on; and after a time the current is reversed, ascending in the chambers in which it had previously descended, and descending in the chambers in which it had previously ascended. The apparatus for conducting the manufacture consists of a series of chambers arranged in a circle, with a conical tower in the centre. The heat given out by the decomposition of the chloride in the chambers is sufficient to produce the required draught through the apparatus without the use of a steam-jet. From the top of the conical tower the gaseous current passes to the condenser

Improvements in the means of preserving animal and vegetable substances. Gabor Naphegyi, merchant, London Wall, London. March 6, 1874.—No. 834. Ethyl and methyl are introduced into a close receptacle containing the substance to be preserved.

Improvements in the means or method of purifying foul water or sewage, and in the apparatus employed in connection therewith. Rupert Goodall, machinery agent, Armley, near Leeds, York. March 7, 1874.—No. 848. This invention has for its object the construction of apparatus to be employed during the process of purification of foul water and sewage, and in the combination of ingredients to be employed.

Improvements in utilising a certain waste or residual product obtained in the manufacture or aniline dyes. George James Hind, Wolverhampton, Stafford. March 11, 1874.—No. 878. This invention consist in revivifying or restoring to its original condition the finely-divided metallic iron which has been oxidised in the manufacture of aniline dyes, and which is ordinarily a waste or residual product, so that the said finely-divided metallic iron can be used over and over again in the manufacture of aniline dyes, or for other purposes where finely-divided iron is required. To effect this object the waste or residual product referred to is heated to a red-heat in admixture with charcoal or other carbonaceous matter so as to reduce the oxide of iron to the metallic state. After the mixture has cooled the metallic iron is separated from the unconsumed carbon by screening or sieving. Or instead of solid carbon, carbonic oxide, or hydrogen, or coal gas in conjunction with heat, may be employed for revivifying the iron.

MEETINGS FOR THE WEEK.

Monday, Nov. 30th.—Royal (Anniversary Meeting).
— Medical, 8.
Tuesday, Dec. 1st.—Civil Engineers, 8.
— Zoological, 8.30.
Wednesday, 2nd.—Society of Arts, 8. "On the Expediency of Protection for Inventions," by F. J. Bramwell, F.R.S
— Geological, 8.
— Microscopical, 8.
— Pharmaceutical, 8.
Thursday, 3rd.—Chemical, 8. "On the Colour of Cupric Chloride, by W. N. Hartley; "On the Formulæ of the Alums," by Sydney Lupton.
Friday, 4th.—Geologists' Association, 8.

TO CORRESPONDENTS.

G. C. S.—Your communication contains no facts of interest to any of our readers, and we cannot occupy valuable space with a merely personal discussion.

Professor Tennant's Lectures on Rocks and METALLIC MINERALS at King's College are given on Wednesday and Friday mornings from 9 to 10 o'clock, and on Thursday evenings from 8 to 9. The Lectures commenced Thursday, January 22nd, and will be continued to Easter.

PRIVATE INSTRUCTION in GEOLOGY and MINERALOGY can be had by Professor Tennant at his residence, 149, Strand, W.C., by those unable to attend public Lectures.

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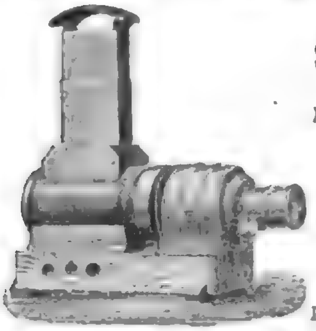

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THE CHEMICAL NEWS.

Vol. XXX. No. 784.

ON THE BITUMINOUS DEPOSITS OF THE VALLEY OF THE PESCARA. SOUTH ITALY.

By Dr. R. CARTER MOFFAT, Professor of Chemistry, Glasgow: Italian Gold Medallist for Industrial Investigations and Discoveries.

The vast deposits of bituminous limestone situated in the valley of the Pescara are of great commercial, value and can be easily and cheaply worked. The district is little known, but in a few years I believe several companies will be at active work in excavating the ore and extracting the bitumen. I spent five weeks inspecting the district professionally last spring, and carried out experiments to ascertain the commercial value of the minerals, and the best modes of extracting the bitumen, and also the manufacture of oil direct from them.

The bituminous rocks of Rocca Morici, San Giorgio, Aqua Fredda, Santa Maria, Fava San Martino, Santa Liberata, Fonticelli, Chiuse, Arrenario, Fondocello, Crocifisso, and Romana are all in the Province of Chieti, and for most part are found in the valley of the Pescara. A railway runs in the valley within a few miles of the deposits connecting with important lines and ports.

Labour is abundant at less than 9d. per day, while wood and peat for fuel are to be had at about 8s. per ton for wood, and 5s. for peat delivered at most of the mines as the deposits are termed.

The limestone with which the bitumen is impregnated varies in character and composition in several of the mines. While the mineral is always calcareous it is in the generality of places magnesian limestone, but in a few of them it is gypsum and selenite.

The amount of bitumen in the ores varies from a few per cents to 50, and it becomes a matter of great importance in selecting a mine (which is to be had for a merely nominal sum) to pay special attention to the experimental determination of the amount of bitumen as derived from a great many trials. Much experience is required to know by sight a very good from a very moderate sample. I have seen many samples apparently very rich in bitumen yield but little when tried.

The best mode of extracting it is by "Bennie's patent retort for manufacturing refined bitumen," which allows of a continuous and uninterrupted working.

Messrs. G. Bennie and Co., Kinning Park Foundry, Glasgow, are well-known and extensive manufacturers of oil-work plant, and indeed make it a speciality, and do little else. The senior partner, Mr. G. Bennie, has frequently visited the bituminous deposits, and has, after minutely studying the matter, devised and patented this apparatus in Italy, which certainly supersedes all other kinds at present used from its simplicity, cheapness, effective and continuous working.

The bitumen so produced is practically pure, and can be sold at present in London for £6 per ton, while it costs only £1 2s. 6d. per ton to produce it at the mine. One ton of mineral can be raised at the rate of 1s. 6d.

When the bitumen is distilled 1 ton yields 100 gallons of oil of sp. gr. 955, giving 25 per cent burning oil of excellent quality and 62 per cent heavy lubricating oil of 950 gravity.

Crude oil is sold in Italy at 8d. per gallon, and burning oil is readily bought up wholesale at 2s. per gallon.

There is a very high rate of import duty on burning oil in Italy, 10d. per gallon being levied on all burning oil imported. Consequently this oil commands more than double the price that it does in this country.

To capitalists the working of these deposits for bitumen and oil hold out, under judicious and intelligent management, the surest prospect of excellent and highly profitable investment.

In my opinion it cannot be long before the great mineral wealth of the district is being turned to good account.

ON ERRORS OF WEIGHING, AND THEIR INFLUENCE ON RESULTS.*

By H. R. PROCTER.

In the following paper I cannot pretend to lay before the Chemical Society any new or original results, but have merely attempted to notice in a concise form the most important errors of weighing, and to give short details of the methods of correction, since, clearly as the principles involved are explained in most text-books, I have, for my own part, found their actual application rather puzzling.

I think it is only fair to myself to say that I had not seen the chapter on the subject in Professor Thorpe's text-book until my paper was in print, and it was too late to re-model it, or I should certainly have avoided going over so much of the same ground. As it is, I am encouraged to let it stand, since the methods I have given are not exactly the same as his; and since I find that, even in the last German edition of Fresenius, no notice is taken of the method of weighing by vibrations, and no detailed rules are given for the correction of weights.

In weighing, as in all other kinds of accurate measurements, the result is vitiated by errors of two kinds; first, those arising from inexact observation and incidental causes, and which are variable in each weighing. These we may call "*errors of observation.*" Secondly, we shall have errors arising from faults in the balance, unequal length of its arms, inaccuracy in the weights, and defects in the mode of weighing, which will occur constantly in all weighing, and which may be called "*instrumental errors.*" Errors of observation may be almost got rid of by taking the average of a large number of experiments; for though each observation will be more or less in error, it will happen that some of the values will be greater, and some less than the truth, and the errors will counteract and destroy each other's influence on the mean result. This, it is obvious, will not be the case with the instrumental errors, for it will generally happen that these will occur constantly on the same side, and so cannot correct each other, but will remain uneliminated in the final average result. Before examining the special corrections which are necessary to remove these, we will consider a little more closely the variable or observation errors.

We have said that the most probable value is obtained by adding all the results of a series of experiments together, and dividing the sum by the number of observations. This mean value will probably differ more or less from each of the individual results. From these differences we may calculate the accuracy of our experiments. If we square each of these differences, add them together, divide them by the number of observations less one, and take the square root of the quotient, we obtain the *mean error of a single observation*, and dividing this by the square root of the number of observations, we obtain the *mean*, or average *error of the final result*. The "*probable errors*" in each case are about ⅓ less than the *mean errors*, and are obtained by multiplying the latter by ⅔, or more accurately by 0·6745. The "probable error" is equally likely to be greater or less than the actual, but unknown, error. Without here considering the rather intricate reasoning which has led to these rules, we may employ them to estimate the scientific value of our determinations.

In the ordinary method of weighing, in which weights are put on until the pointer swings to equal distances on each side of the zero, there are several sources of inaccuracy of observation, even supposing the balance were perfect. In the first place, it is not possible *exactly* to hit the right weight in any finite number of trials, although we may come as near it as we please. Secondly, as the swing of the balance gradually diminishes, it is difficult to tell when the exact zero is obtained.

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* A Paper read before the Newcastle-upon-Tyne Chemical Societ

A much better method, more rapid, as well as more accurate, is as follows:—After adding weights in the ordinary way, till we are, say, less than a milligramme below the weights required, we note the limits of an uneven number, say five, consecutive swings of the balance. Finding the average limit of swing on each side, and again taking the average of these two, we obtain the position in which the index would settle if the balance were at rest. This will be at some little distance to one side of the zero of the unloaded balance. Adding now 1 milligramme to the weights, another position of rest may be observed. Then, by rule of three, as the distance of the first point from the zero of the unloaded balance is to its distance from the point with 1 milligramme added, so is the fraction of the milligramme required to the whole milligramme put on. A numerical example will make this clearer. To avoid *minus* quantities, we reckon the scale of the balance from the side on which the weight scale is hung, so that the centre of the scale will count 10 instead of 0, and additional weights will give greater readings. Fractional parts of divisions are estimated, which is very easy if the balance swings only once in 15 or 20 seconds. Suppose our successive turning-points are, with the weight, *w*, on the scale—

							Means.	Position of rest.
Right	..	7·5		7·6		7·8	7·63	9·49
Left	..		11·4		11·3		11·35	

and that we have similarly obtained 10·34 as the position of rest of the unloaded balance, and 11·29 with $w + 1$ m.grm.; subtracting 9·49 from these, we obtain the differences 0·85 and 1·80, and our required weight will be $w + \frac{.85}{1.80}$ m.grm, or $w + 0.47$ m.grm. Though this method looks rather complicated, it is really done very quickly, since there are no useless trials, as in the ordinary way; but the labour may be still further lessened by the construction of a table of deflections of the balance for 1 m.grm., with different loads. Then, for any observed deflection from zero, the corresponding weight may be at once taken from the table. As specimen of such a table, I give one constructed for my own balance at the end of the paper. Such tables must be verified occasionally, as the sensitiveness of a balance is liable to slight variations. It is also necessary frequently to determine the zero-point when heavy loads are used, whatever mode of weighing be adopted.

So far, we have assumed that, when the pointer was at the zero of the unloaded balance, the two loads were truly of equal weight; but, in order that this may be the case, the two arms of the balance must be of exactly equal length, a condition which is never rigorously fulfilled. Indeed, it is possible that it should, since an error of only 1-10,000th of an inch in a balance with 14-inch beam would cause an error of nearly 1¼ m.grms. with a load of 100 grms. For chemical purposes, where only relative weights are required, this may be neglected if the weights are always placed on the same scale. Where absolute weighing is necessary, as, for instance, in testing a set of weights, we must eliminate the error. I need scarcely advert to the methods of doing this by substitution and double weighing. In the first case, the weights are tared, and the substance to be weighed is then placed on the same scale, and weights removed till a balance is again obtained. In the second, the substance is weighed first on one scale and then on the other, and the mean of the two results is taken, and the errors, being equal and in opposite directions, will balance and destroy each other. Another way is once for all to determine the ratio of the arms, and then the true weight is obtained from any observed weight by multiplying by this ratio; or, still better, a table may be constructed giving the calculated corrections for different loads. As the ratio is very small, it is best found by observing the deflection in the following manner:—The zero of the balance when oscillating unloaded is observed; then two approximately equal large weights are put on—say, 50 grms. on each scale—and the zero observed again. The weights are changed to the opposite scales, to eliminate any small inaccuracy in their equality, and the process is repeated, finishing by observing the zero of the unloaded balance a second time. Then the means of the two loaded and unloaded zeros are taken, and the difference between these reduced to m.grms., as described before, is the correction to be added or subtracted for the load employed; and the ratio of the two loads so corrected is the same as that of the *opposite* balance arms. I need scarcely say that the addition must be made to the load *towards* which the pointer is deflected, or the *subtraction* from the *opposite* side. Having found the correction for any load, that for any other may be found by rule-of-three. Thus, if that for 100 grms. is 3 m.grms., that for 50 will be 1·5 m.grms. In my own balance, a very good one by August Sauter, of Ebingen, it amounts to about 2 m.grms. per 100 grms., and consequently the ratio of the arms is as 1 to 1·00002. As the correction is small, it is never necessary to apply it to the smaller weights, and, indeed, a table of values for every 5 or 10 grms. would generally be sufficient.

Another, and still more important, source of instrumental error is the inexactness of the weights; and no ordinary set, even of the best makers, is really accurate. It is, therefore, always necessary to examine them and make a table of corrections. The simplest way of doing this is to assume, provisionally, that the smallest weight, say, the c.gr., is accurate, and then to determine all the rest in terms of it, preferably by double weighing. Of course, weights of the same name must be distinguished by marks of some kind—dots made with a centre-punch are as good as any. It will be easy to weigh one c.gr. against the other, and then with these to weigh the 2 c.gr., and so on. Suppose the second c.gr. is found (by deflection or the use of the rider) to weigh, say, 10·01 m.grms., the two together must be called 20·01 m.grms., and the error may go on accumulating till, with the largest weights, it amounts even to grms.; but this is of no consequence. If we have no normal weight with which to compare our set, it is generally best to assume the sum of the large weights as correct. Suppose, now, that they weigh 103·754 grms. in terms of the 1 c.gr. weight, instead of 100 grms., the true amount, we must divide all our observed weights by 1·03754 (or multiply by its reciprocal) in order to obtain a series of numbers which shall actually represent the relative values of our weights, and which will add up to exactly 100 grms. That they do this is a proof of the correctness of the numerical work. If we always use the weights in the same order, it will now be easy to make a table showing the whole correction to be added to any observed weight. It will be seen that in some cases it amounts to almost half a milligramme, quite an important error in an organic analysis.

A source of error almost universally neglected, is that caused by the weighing being conducted in air instead of *in vacuo*. To illustrate the principle by an extreme case, we know that, while a cork weighed in water would weigh less than nothing, a lead bullet would lose comparatively very little. In a less degree, the air has exactly the same effect as the water, and in weighing bodies of low specific gravity with dense weights, such as brass or platinum, the loss may amount to something considerable. For instance, in weighing 100 c.c. of water with brass weights it would amount to 10·6 m.grms. If absolute accuracy were required, it would be necessary also to take account of the changes of density of the air as shown by temperature and barometric pressure, but for chemical purposes this could scarcely be important, except in determination of vapour densities. I therefore content myself with giving at the end of the paper a table for correcting weighings with brass weights at ordinary temperatures, and refer for further information to special articles on such determinations. To show the importance of at least a rough correction, even in ordinary chemical work, Professor Kohlrausch points out that, in the common case of determination of Ag as AgCl in a weighed quantity of a dilute solution, the correction may influence the result as much as $\frac{1}{10}$th per cent.

In conclusion, I must say a few words on the influence of errors on results. It is but rarely that we can directly weigh the substance we are estimating, but in most cases we have to weigh some compound, and multiply the observed weight by a factor, to reduce it to that of the substance required. The errors will obviously be multiplied at the same time, and hence, other things being equal, the smaller the factor, or in other words, the larger the atomic weight of the compound weighed, the less influence errors will have on the result. Thus, in an organic analysis, an error in weighing the substance at first goes directly into the result, while 1 m.grm. error in the weight of the potash bulbs will only make $\frac{3}{11}$ m.grm., and in the calcic chloride tube $\frac{1}{9}$ m.grm., difference in the result. We should always, at least in scientific work, make a rough estimate, at any rate, of the probable influence of the various corrections, and only neglect them when we find their amount small compared to the probable error from other sources. This will frequently be the case, but not always, and the information as to the amount of accuracy we may expect from our results is often very important; as, for instance, in fitting an empirical formula to an analysis. Let us take the common case of sulphur determination as baric sulphate, say, in a pyrites containing 50 per cent. Supposing I use 1 grm. of the substance, the probable error of weighing with my balance (as estimated from the differences in a series of ten weighings of the same mass) will be about 0·1 m.grm., or only 0·01 per cent, the correction for inequality of balance arms, and the reduction to *vacuo* practically *nil*, as baric sulphate and pyrites are both weighed on the same scale, and are nearly of the same density; while the error of weights may amount to nearly 0·05 per cent. Here we see that, while all the other corrections may be disregarded, it would be quite inadmissible scientifically, whatever it might be commercially, to carry the percentage result to two places of decimals while neglecting the error of the weights. To sum up, the inequality of balance-arms may be neglected in all ordinary chemical work, the reduction to *vacuo* is only necessary when the substance has to be weighed in two forms of very different density, but the weights must always be corrected, and the zero-point of the unloaded balance constantly observed, since its variation is one of the principal sources of observation error. It is well to estimate the probable amount of the latter, by occasionally doing a series of weighings of the same mass, and observing the unloaded zero-point each time; and, whenever we have a series of analyses of the same substance, we should calculate the probable error of the final results by the rules given above. If this were done, it would, I venture to think, be found that only in very rare cases it is scientifically allowable to carry percentage results to two places of decimals, since even the errors of weighing alone, with excellent instruments and great care, will seriously falsify the last figure.

Deflection of Balance corresponding to

With load of	0·1 m.grm.	0·2 m.grm.	0·3 m.grm.	0·4 m.grm.	0·5 m.grm.	0·6 m.grm.	0·7 m.grm.	0·8 m.grm.	0·9 m.grm.	1·0 m.grm.	
0 grm.	0·26	0·51	0·77	1·02	1·28	1·53	1·79	2·04	2·30	2·55	div.
10 ,,	0·24	0·48	0·72	0·96	1·20	1·41	1·68	1·92	2·16	2·40	,,
20 ,,	0·19	0·38	0·56	0·75	0·94	1·13	1·32	1·50	1·69	1·88	,,
30 ,,	0·19	0·38	0·56	0·75	0·94	1·13	1·32	1·50	1·69	1·88	,,
40 ,,	0·19	0·38	0·57	0·76	0·95	1·14	1·33	1·52	1·71	1·90	,,
50 ,,	0·17	0·34	0·50	0·67	0·84	1·01	1·18	1·34	1·51	1·68	,,
60 ,,	0·16	0·33	0·49	0·66	0·82	0·98	1·15	1·31	1·48	1·64	,,
70 ,,	0·16	0·32	0·47	0·63	0·79	0·95	1·11	1·26	1·42	1·58	,,
80 ,,	0·16	0·32	0·47	0·63	0·79	0·95	1·11	1·26	1·42	1·58	,,
90 ,,	0·13	0·26	0·40	0·53	0·66	0·79	0·92	1·06	1·19	1·32	,,
100 ,,	0·13	0·26	0·38	0·50	0·63	0·75	0·88	1·00	1·13	1·25	,,

Reduction of a Weighing with Brass Weights to Weight in Vacuo.

Δ.	K.	Δ.	K.
0·7	+ 1·57	2·0	+ 0·46
0·8	+ 1·36	3·0	+ 0·26
0·9	+ 1·19	4·0	+ 0·16
1·0	+ 1·06	5·0	+ 0·10
1·1	+ 0·95	6·0	+ 0·06
1·2	+ 0·86	7·0	+ 0·03
1·3	+ 0·78	8·0	+ 0·01
1·4	+ 0·71	9·0	− 0·01
1·5	+ 0·66	10·0	− 0·02
1·6	+ 0·61	12·0	− 0·04
1·7	+ 0·56	14·0	− 0·06
1·8	+ 0·52	16·0	− 0·07
1·9	+ 0·49	18·0	− 0·08
2·0	+ 0·46	20·0	− 0·08

$$\frac{k}{1000} = 0{\cdot}0012\left(\frac{1}{\Delta} - \frac{1}{8{\cdot}4}\right).$$

If the weighed body has the density Δ, and its weight in air be *m* grms., *mk* m.grm. must be added to reduce the weighing to *vacuo*.

ON A

COLORIMETRIC METHOD OF DETERMINING IRON IN WATERS.*

By THOMAS CARNELLEY, B.Sc.

Of late years the analysis of water has become of such importance that any improvement in the methods employed in that analysis will, it is thought, be acceptable, however small such improvement may be; and it is with this consideration that the following paper is submitted to the Society.

In the determination of heavy metals in water, with the exception of lead, great inconvenience arises from the want of rapid and accurate methods of estimating very small quantities, and it is to remedy this inconvenience in the case of iron that the following method is proposed:—Besides accuracy, it fulfils both the other requisites, viz., rapidity and the power of determining exceedingly small quantities; for without any evaporation 1 part of iron in 13,000,000 parts of water can be detected and a determination made in less than fifteen minutes; the smallest amount of ammonia which can be detected by the well-known Nessler test, without contraction, being only 1 part of ammonia in 20,000,000 parts of water; and moreover, as water will admit of evaporation without loss of any iron it may contain, the iron which can be estimated may be reduced to almost an infinitely small quantity.

The method consists in the comparison of the blue colours produced by adding to a solution of potassium ferrocyanide, first, a solution of iron of known strength, and, secondly, the water in which the iron is to be determined.

The standard solutions and materials required are as follows:—

(1.) *Standard Iron Solution.*—This is prepared by weighing out 0·7 grm. of ammonio-ferrous sulphate (=0·1 grm. Fe), dissolving the water, and adding 1 c.c. of the sulphuric acid; the iron is next oxidised by adding an exact sufficiency of the potassium permanganate solution from a burette, and the whole diluted to 1 litre. Of this solution 1 c.c. = 0·0001 grm. Fe.

(2.) *Solution of Potassium Permanganate.*—This must be moderately dilute, but it is not necessary that it should be of standard strength.

(3.) *Standard Nitric Acid*—is prepared by diluting 50 c.c. of pure strong nitric acid to 1 litre.

(4.) *Potassium Ferrocyanide Solution*—is obtained by dissolving 1 part of the salt in 25 parts of water.

(5.) *Strong Sulphuric Acid*—diluted with an equal volume of water.

(6.) *Two similar Glass Cylinders and a Glass Rod.*—The former should hold rather more than 200 c.c. each, the point equivalent to that measure being marked on the glass.

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* A paper read before the Manchester Literary and Philosophical Society.

(7.) *A Burette*—marked to $\frac{1}{10}$ c.c. for the iron solution, and an ordinary burette for the permanganate.

(8.) *Three 1 c.c. Pipettes*—for the ferrocyanide, nitric acid, and sulphuric acid respectively, the one for the last being marked also to deliver ½ c.c.

The following is the method of analysis employed:—A measured quantity of the water, less than 1 litre in bulk, is taken, the amount being regulated according to the quantity of iron contained in the water, which is judged by a previously made qualitative experiment, of adding 1 c.c. of the ferrocyanide to a portion of the oxidised water: 1 c.c. of the sulphuric acid is added, and then the permanganate from a burette, till a permanent faint pink colour is obtained; the whole is made up to 1 litre, when it forms what may be called the "water-test solution." Into each of the cylinders 1 c.c. of the potassium ferrocyanide is added, and then a measured quantity of the water-test solution put into one of them (*x*); both are next filled with water up to the mark, and 1 c.c. of the standard nitric acid added to each. After (*x*) has been well stirred, the standard iron solution is gradually run into (*y*), the liquid being stirred after each addition, and the colours in the two cylinders compared by placing them side by side over a sheet of white paper in front of a window: this is repeated till the colours in each of the cylinders appear to be equal, which point completes the operation.

Every cubic centimetre of iron solution used corresponds to 0·1 m.grm. of iron, from which the amount of iron added to cylinder (*y*) can be calculated. Then, assuming that equal shades of colour are, *ceteris paribus*, produced by equal weights of iron, the amount of the latter in cylinder (*x*) is equal to that added to (*y*), and since the volume of the original sample of water in the test solution is known, and also the volume of the latter put into (*x*), the amount of iron in a measured quantity of water can therefore be calculated. The volume of the test solution put into cylinder (*x*) should be such as not to require more than 5 c.c. of the iron solution to be added to (*y*) to produce an equal shade, for if more be added the colour obtained would be too dark to compare with ease and accuracy.

If the sample of water contains such a small amount of iron as, after oxidation, not to give a colouration directly with the ferrocyanide and nitric acid, a sufficient quantity of it must be evaporated with ½ a cubic centimetre of the sulphuric acid till it occupies from 100 to 200 c.c. The liquid is then poured into a flask, together with the rinsings, and oxidised with permanganate to a very slight excess, and then filtered so as to separate any precipitate, and also to destroy the excess of permanganate. The fluid thus obtained is next tested as before, by adding the whole or a known part of it to one of the cylinders containing the ferrocyanide. When the water, after being filtered, has still a cloudy appearance, as is the case with sewage and polluted rivers, &c., a known quantity of the filtered water must be evaporated to dryness and ignited, the residue dissolved in a small quantity of hydrochloric acid, and filtered, washed with water, and the free acid in the filtrate as nearly as possible neutralised with ammonia and then 1 c.c. of sulphuric acid, after which oxidised with permanganate, then filtered—if requisite—to destroy excess of permanganate, and the iron estimated as before. A green colour may be sometimes obtained instead of the pure blue: this is owing to a slight quantity of unreduced permanganate being present: this, however, is of no consequence, as with a little practice the green tint may be compared with the blue, and correct results obtained; still the comparison may be rendered easier by adding one to two drops of permanganate to the cylinder to which the standard iron is run, and which by this means will also assume a green tint. Experiments were made with reference to this point, and it was found that the presence of not more than a few drops of unreduced permanganate has little or no effect on the results obtained, the only consequence being the change of tint, but not of depth of colour.

Potassium permanganate is employed as the oxidiser instead of the nitric acid, because—(1.) The oxidation is performed much quicker than it would be if nitric acid were used, and in the latter case the liquid would have to be heated. (2.) It can be added to exactly the right point, which could not easily be done with nitric acid. (3.) An excess of the latter is very detrimental to the accuracy of the method, for, from experiments made in relation to this point, it was found that when the amount of free acid present in 200 c.c. was more than 0·0025 c.c. of the strong acid, it renders the colour deeper than it otherwise would be.

One cubic centimetre of the standard nitric acid is added to each of the cylinders, because—(1.) It renders the reaction much more delicate. (2.) Because the colours produced in the presence of this amount of free acid are almost always of the same tint, being of a pure blue, whilst when no free acid is present the colour varies—even when apparently of the same depth—from a blue to a bluish-green, which renders them less easy to compare. (3.) Because it destroys the effect which the presence of a small quantity of any free acid, previously existing in the liquid, might have in altering the shade of colour produced; for from a series of experiments made with reference to this point also, it was found that when the amount of free acid present, in addition to the 1 c.c. of standard nitric acid added, is only small,—*i.e.*, less than 0·05 c.c. of the strong acid in 200 c.c. of water,—it has no effect on the depth of colour produced. When any free acid exists in the water to be examined, it must, before being oxidised, be made as nearly neutral as possible with ammonia, and the iron then determined.

The following are some of the results obtained on determining the iron in solutions of known strength:—

Iron Found. Milligrammes.	Iron Calculated. Milligrammes.
17·990	19·480
4·200	4·140
1·800	1·860
0·610 with salts (C) present	0·570
0·510	0·520
0·400	0·410
0·400 with KNO_3 (D) present	0·400
0·330	0·300
0·280	0·310
0·230 with salts (B) present	0·220
0·200	0·210
0·140	0·160
0·120	0·100
0·070	0·078
0·025	0·031

In order also to test the effect which the presence of different salts has on this method, four series of experiments were made by adding known weights of the following salts to 1 litre of the ammonio-ferrous sulphate solution:—

(A.) Calcium sulphate, magnesium sulphate, ammonium chloride, sodium chloride, and potassium carbonate, in all 1·6 grm.

(B.) Ditto, in all 0·9 grm.

(C.) Magnesium sulphate, ammonium chloride, potassium carbonate, sodium chloride, and calcium chloride, in all 0·8 grm.

(D.) Potassium nitrate, 0·4 grm.

The solutions thus obtained were oxidised with permanganate and sulphuric acid diluted to 1 litre, and the iron estimated as previously described. The results obtained are given below, the letters attached denoting to which of the preceding series they severally belong, and from them it will be seen that the presence of these salts has little or no effect.

It was also found that neutral organic matter is not detrimental to the method.

With reference to the delicacy of the method it was found, as a mean of seven experiments, that 0·0055 m.grm. of iron gives a very distinct colour on the surface, and that

0·015 m.grm. gives a blue colour on being stirred with 200 c.c. of water, and therefore that 1 part of iron produces a blue colouration in 13,000,000 parts of water containing ferrocyanide of potassium and nitric acid. According to Hartig,* however, 1 part of iron (in the form of sulphate) only produces a colour in 600,000 parts of water containing ferrocyanide. The difference of these results is due to the effect which the presence of the small quantity of free nitric acid, added in the new method, has in increasing the delicacy of the reaction.

As to the smallest differences of reading which can be detected, it was found that when any quantity of iron solution below 1 c.c. had been added, a difference of 0·05 c.c. can be discriminated; above 1 and below 2 c.c., a difference of 0·1 c.c.; above 2 and below 4 c.c., a difference of 0·2 c.c.; and above 4 and below 5 c.c., a difference of 0·3 c.c.

The following are a few samples of different waters in which the iron has been determined as described above:—

Parts per 1,000,000.

Date. 1874.	Name of Water.	Amount used in Analysis.	By New Method.	By $KMnO_4$.	As found by other Observers
Feb. 14	Manchester Water Supply	5 litres	0·21		0·287 R. A. Smith, 1864
Mar. 20	,, ,, ...	1 litre	0·18		
——	,, ,, ...	2 litres	0·175		
July 15	,, ,, ...	1 litre	0·10		
——	,, ,, ...	1 ,,	0·11		
Aug. 31	,, ,, ...	1 ,,	0·27		
Sept. 1	,, ,, ...	1 ,,	0·18		
,, 2	,, ,, ...	1 ,,	0·26		
——	,, ,, ...	1 ,,	0·27		
Sept. 3	,, ,, ...	½ ,,	0·30		
——	,, ,, ...	1 ,,	0·32		
Sept. 4	,, ,, ...	½ ,,	0·38		
——	,, ,, ...	1 ,,	0·36		
Sept. 5	,, ,, ...	½ ,,	0·42		
——	,, ,, ...	1 ,,	0·41		
Feb. 19	Medicinal Spring, Trefriew, N. Wales..	30 c.c.	1600·00	1575·50*	
Feb. —	Chloride of Iron Spa, Harrogate	50 ,,	290·00	290·34	289·40 H. Davies, Feb., 1872.
Feb. 16	River Irwell, near Pomona Gardens ..	¾ litre	0·86		
Feb. 18	River Mersey, Northenden	1½ litres	0·48		
Feb. 23	River Dane, above Congleton	1 litre	0·57		
——	,, below ,, ...	¾ ,,	0·44		
——	Liverpool Water Works, Compensa. Water, White Coppice Heapy	2 litres	0·42		
Jan. 3	Barnsley Water Supply	2½ ,,	0·25		
Feb. —	River Thames, London Bridge	1 litre	0·19		
Jan. 3	Cockerham Well, Barnsley	2 litres	0·075		
Feb. —	New River Company	1 litre	0·050		Trace } Graham, Miller, and Hofmann.
——	Lambeth	1 ,,	0·044		12·1 (Al_2O_3 & Fe_2O_3)
——	East London	1 ,,	0·038		6·8 (,, ,,)
Jan. 3	Friars' Well, Barnsley	1¾ litre	0·005		

* The author hopes shortly to bring an analysis of this water before the Society.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 3, 1874.

Rev. William Gaskell, M.A., Vice-President, in the Chair.

Mr. William Carleton Williams, F.C.S.; Mr. Harry Grimshaw, F.C.S.; and Mr. William E. A. Axon, M.R.S.L., F.S.I., were elected Ordinary Members of the Society.

"*On the Corrosion of Leaden Hot-water Cisterns,*" by Professor H. E. Roscoe, F.R.S., &c.

As the question of the occurrence of lead in town's water has been brought forward in the daily papers, I think it right (whilst stating my experience of many years' duration to be that the Manchester Corporation water when cold does not take up lead from the pipes under ordinary circumstances) to guard persons from using for drinking purposes water drawn from hot-water cisterns made of lead.

My friend, Mr. Melland, Surgeon, of Rusholme, handed to me a white powder taken from the inside of the covering of his leaden hot-water cistern, which presented a honeycombed surface, and in many places stalactitic masses hung down which were from ½ to ¼ of an inch in length.

This powder consisted of a hydrocarbonate of lead, giving the following results of analysis:—

Lead oxide (PbO)	85·67
Carbonic acid (CO_2)	12·12
Water (H_2O)	2·21
	100·00

It was doubtless formed by the solvent action of the condensed water containing oxygen upon the metal and the subsequent formation of the insoluble hydrocarbonate, and there can be little doubt that water drawn from such a cistern would be contaminated with lead.

"*On an Improvement of the Bunsen Burner for Spectrum Analysis.*" By F. Kingdon, Assistant in the Physical Laboratory, Owens College.

The students in the Physical Laboratory of Owens College having occasionally experienced some difficulty in obtaining the spectra of some salts with the ordinary Bunsen, through apparently a deficiency of pressure in the gas, it occurred to me that the amount of light even at this deficient temperature might be increased by multiplying the number of luminous points. This is accomplished by broadening out the flame of the Bunsen, that is, causing the gas to issue through a narrow slit instead of a round hole. We have, so far, only made a rough experiment, the slit being about ¾in. long and ⅛in. wide. The result is, as expected, a more brilliant spectrum.

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* *Journ. Prakt. Chem.*, 22, 51.

"*On the Existence of a Lunar Atmosphere.*" By DAVID WINSTANLEY.

The non-existence of a lunar atmosphere is spoken of by many astronomical writers as confidently as if it were a demonstrated fact. It is certain, however, that it is not a demonstrated fact, and it is certain, also, that if a fact at all, it is undemonstrable.

The failure of any optical test, however delicate, to detect the existence of such an atmosphere still leaves another alternative open to us than the inference of atmospheric non-existence, namely, the existence of an atmosphere in quantity below the minimum discernible by the means employed.

The non-existence of an atmosphere about the moon comparable in density with that which surrounds the earth, may indeed be regarded as an established fact; but the total non-existence of such an atmosphere is certainly an unwarranted conclusion.

I shall endeavour to show presently that the refraction of a ray of light is not the most delicate test which can be employed for the determination of the point in question. But even this test has yielded indications which astronomers of note have construed into evidence of a lunar atmosphere of considerable attenuation. Arago, for instance, has observed on more than one occasion the apparent adhesion of a star for three or four seconds to the dark limb of the moon after it had been perceived to be in contact with it, and he has also observed a very sensible diminution of brightness previous to immersion.

From the distortion of the visible segment of the solar disc, observed by Euler during the eclipse of 1748, Du Sejour, after making corrections for the effects of irradiation, arrived at the conclusion that the moon possesses an atmosphere having a horizontal refraction of 1·5″, and which is therefore 1·400 times more rare than common atmospheric air upon the surface of the earth.

A phenomenon similar in kind to the twilight of the earth has been recognised by Shroeter, in the form of a faint crepuscular light extending from each of the lunar cusps along the circumference of the unenlightened portion of her disc, from which he has been enabled to deduce the existence of an atmospheric envelope about our satellite capable at an elevation of 5000 feet above her surface of causing a sensible inflexion of the light proceeding from a celestial body. But as the moon would describe an arc representing this amount in less than two seconds of time, "the circumstance has been adduced as affording a sufficient explanation of the difficulty of detecting a lunar atmosphere in the phenomena of occultations."

Chromatic dispersion is the test which in certain circumstances at any rate seems to offer better opportunities for ascertaining positively the existence of a lunar atmosphere than the test of simple refraction. It would cause the colour of an occulted object to change, making it green, and finally blue at the instant of disappearance.

The direct telescopic observation, by which alone this appearance could be noticed, would, from the operation of circumstances upon which I need not dwell, probably lead only to results of uncertainty. At the same time it is but proper to remark that appearances have been observed at eclipses of the sun suggestive of this phenomenon, and which have been interpreted by Flamsteed as indicating the existence of a lunar atmosphere. The particular circumstances in which, as I take it, chromatic dispersion may afford weighty evidence of the existence of a lunar atmosphere occur when the body occulted by the moon is one of considerable angular magnitude and great intrinsic splendour. Then it is manifest that the chromatic dispersion effected by such an atmosphere would cause the projections of prismatic bands upon the earth, forming, as it were, an iris on the borders of the shadow, and bathing the landscape and the clouds in all the rainbow hues. These circumstances it will be seen exist during the totality of a solar eclipse, and the rainbow hues bathing alike the landscape and the sky, which I have indicated as the inevitable consequences of chromatic dispersion by a lunar atmosphere, would seem to be almost constant accompaniments of such eclipses. "As early as the year 840 it was remarked that during the total eclipse of the sun which happened in that year the colours of objects on the earth were changed." "Kepler mentions that during the eclipse which occurred in the Autumn of 1590 the reapers in Styria noticed that everything had a yellow tinge," whilst during that which took place in 1706 objects were observed to change their colour, now appearing of an orange-yellow, and now of a reddish tinge.

The illustrious Edmund Halley remarked that the face and colour of the sky were changed during the eclipse observed by him in 1715. "The serene azure of the sky," he says, "turned to a more dusky livid colour, intermingled with a tinge of purple, and grew darker and darker until the total immersion of the sun." Sir John Clarke, in his account of the eclipse of 1737, states that "the ground was covered with a dark greenish colour," whilst in the eclipse of 1842 "it was *universally* remarked that the colours of terrestrial objects were changed." Mr. Hind says that after the totality had commenced "the southern heavens were of a uniform and purple grey." "In the zenith and north of it the heavens were of a purplish violet, while in the north-west and north-east broad bands of yellowish crimson light, intensely bright, produced an effect which no person who witnessed it can forget." "The crimson," he says, "appeared to run over large portions of the sky, *irrespective of the clouds*," a circumstance certainly suggestive of a cause differing from that which gives rise to the hues of sunset. "All nature," continues Mr. Hind, "seemed to be overshadowed by an unnatural gloom; the distant hills were hardly visible; the sea turned lurid red, and persons standing near the observer had a pale and livid look." Not only did the colours "run over large portions of the sky, irrespective of the clouds," but they were visible at stations so remote from one another as to give additional assurance of an extra-terrestrial origin. The *distribution* of the colours observed by Mr. Hind at Rævelsberg is consistent with the theory of their production by the chromatic dispersion of a lunar atmosphere, whilst the *order of their succession*, as stated by Sig. Piola who observed in Italy, and the sudden *change* of colours noticed by Mr. Lowe, and which took place as the shadow swept along, afford confirmation of the theory.

It has been suggested by Mr. Lockyer that the colours projected upon the landscape during the continuance of a total solar eclipse may be those of various layers of the chromosphere alternately disclosed by that great screen the moon in its passage over the solar disc. Manifestly, however, the purity of some of the colours would be interfered with, assuming them to be produced in this manner, and the yellow which is so frequently seen would seem to be unaccounted for. It is not unlikely that further and special observations will be required to say of either of these theories that it may or may not be maintained

In the meantime, considering that the non-existence of a lunar atmosphere is undemonstrated and undemonstrable, that it is in opposition to analogy, and that even simple refraction has given evidence of such an inconsiderable atmospheric envelope as we might at most expect a body of the moon's small mass to have, it certainly seems to me that the balance of probability lies in favour of the theory that the rainbow hues observed at total eclipses of the sun are really the results of chromatic dispersion effected by a lunar atmosphere.

CORRESPONDENCE.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—I am glad to see in your columns another communication on the above subject from Sir F. C. Knowles, for the unfortunate datum in his original paper has probably drawn the attention of some of your readers from the views he sought to illustrate. Some of these views, by the mere fact of their statement by him, indicate either real ambiguity in the language of chemistry, or at least imperfect or erroneous enunciations in the books he consulted, while others are not without interest of a wider kind.

If in the two equations $A+B=C$ and

$$\frac{A}{a}+\frac{B}{b}=\frac{C}{c}$$

we assign to the letters the meanings mentioned in the original paper (Chemical News, vol. xxx., p. 199), the first equation, in which of course the sign = implies numerical equality, with all the consequences that result therefrom, is the expression of the widest inductive generalisation of chemistry, namely, that which affirms that the quantity of matter is unchangeable. But the second equation being as the obvious relation

$$\frac{\text{weight}}{\text{specific gravity}}=\text{volume}$$

indicates a statement to the effect that the volume of a compound gas is always equal to the sum of the volumes of its components before combination embodies a proportion to which no one acquainted with the elementary fact of chemistry would advisedly assent. It is indeed the algebraical form of the fallacy which the author supposed had obtained credit among chemists, namely, "that the numerical relation between the atomic weights and that between the atomic volumes are identical." I imagine that this notion was derived from some loosely worded statement of the fact that the same equation which expresses the relative weights of the substances concerned in a reaction, expresses also, if it be properly written, the relative gaseous volumes, *e.g.* :—

$$2H_2O+O_2=2H_2O$$
$$2NH_3=N_2+3H_2$$

The sign of equality applies only to the ponderal relations, but the *coefficients* of the molecular expressions inform us also of the relative volumes concerned, while the sign = in regard to them merely separates the products of the reaction from the substances which enter into it. Some authors have expressed such volumetric results thus :—

2 vols. + 1 vol. = 2 vols.
2 vols. = 1 vol. + 3 vols.

This appears a forced and unnecessary use of the sign of equality, for the short word "yield" would clearly express the real meaning. The adoption of (÷) the sign of division, in such relations, would be of advantage only in expressing condensation ratios. I believe also that our chemical notation which uses juxtaposition and the sign + with *different* significations, would lose immensely in clearness and compactness by the substitution of the additive sign for the former, and conformity to algebraic conventions would be dearly paid for by the confusing array of brackets which would become necessary.

The statement which, it appears, the author had in view when he applied the *reductio ad absurdum* test, does not present itself in the original paper in connection with the foot-note, which, as printed, is made to refer to quite another statement, namely, that from which I said that the value 0·414 as the density of carbon vapour was deducible. This number, Sir F. C. Knowles says, is inaccurate, being only half the correct value. But this number and the statement from which it is derived are as correct as those which he now substitutes in his letter. Both depend entirely in each case upon the atomic constitution we choose to attribute to the carbon-gas molecule, and experimental data, and adequate grounds for analogical reasoning are alike wanting, carbon-gas being purely imaginary so far as regards a direct determination of its density, and the element itself in many respects exceptional.

In the original paper the author desires "some happy hypothesis . . . to determine, *a priori*, the specific gravity of a molecule from the separate specific gravities of its constituent atoms," and in his letter he says—"If we are ever able to express the specific gravity of a compound in a function of the specific gravities of the components, all the latter must be included." No doubt. Unless I misunderstand his meaning, I think we already possess this happy hypothesis in that of Avogadro, as a consequence of which, when we know what are the constituent atoms of a molecule, we find the specific gravity (hydrogen = 1) by taking half the sum of the atomic weights. But as a matter of fact the hypothesis is worked the other way, for chemists constantly determine the molecular constitution from the specific gravity, which furnishes a criterion that other considerations may confirm, but which they are never permitted to overthrow. Let us suppose, however, that assuming the specific gravity of hydrogen gas as unity, we have ascertained that of carbon gas to be 12. Now any function of the numbers 1 and 12 which possibly could, in each particular case, express, *a priori*, the gaseous densities of the numberless compounds of hydrogen and carbon, must have a factor determined by some circumstances or property belonging to, and serving to identify, the hydrocarbon in question. If the numbers of the atoms of each constituent which build up the molecule are supposed known, we have already the author's desideratum; but, as already stated, chemists reason *from* the specific gravity to the molecular constitution. If it be not the latter which is to supply the particular factor for each case, in what circumstance peculiar to each hydrocarbon must it be sought? What would be the gain to science were the specific gravity determinable *a priori* in each case, if the observations necessary for its determination should be of a more complicated character than the direct measurement of the density? Even the advantage to theory which might accrue by thus establishing an invariable connection between density and the more complicated circumstances, would equally result from the tracing back of the connection from the more easily reached starting-point. It is, in truth, the gaseous density which furnishes (the percentage composition of a substance being known) the most reliable datum for the determination of the molecular constitution, and specific gravities derive all their importanse in Chemistry from this fact. It would be interesting to learn from Sir F. C. Knowles by what more easily observed property or identifying circumstance he can imagine hydrocarbons (say) to furnish the additional factor for the desired function.—I am, &c.,

R. Routledge.

London, November 30, 1874.

IRON IN CHAR.

To the Editor of the Chemical News.

Sir,—In the Chemical News of November 27th, there appears a letter from Mr. Martin Murphy, of Liverpool, with regard to my paper on ferrous sulphide in char.

In Mr. Martin Murphy's communication there are one or two points which seem to concern me, and, with your permission, I will briefly refer to them in order :—

The amount of sulphur evolved from any char, as H_2S by means of HCl, does not express the total amount of that element existing in the state of sulphides. This I hope to show shortly as the result of experiment. Let Mr. Murphy, if he doubts, take a sample of any char rich in sulphides, and evaporate to dryness with HCl at 100°. Then let him digest the powdered residue with rectified carbon disulphide, whose purity has been previously verified. On evaporation, he will obtain a weighable amount of sulphur. I merely mention this in passing, as, with all due respect, Mr. M. Murphy's method of estimating sulphides appears rather antiquated. He grounds his disbelief of the existence of FeS in char, upon the assertion that in certain samples he found too little iron to satisfy all the sulphur evolved by HCl. Well, whatever sulphur was left over should have been calculated as calcium sulphide. There are two kinds of sulphides, which, for the sake of using their names in a sugar-house, we may term—1. Temporary sulphur. 2. Permanent sulphur.

It is of the utmost importance to all refiners that chemists should most distinctly specify in their reports how much of each of these two sulphides any char contains.—1. Given, a char containing hardly any iron, when heated sufficiently to produce sulphides, of course they will be those of calcium. After passing through the round of treatment, on arriving at the kiln-head sulphides will be found absent. They are temporary, and easily removable.

2. Given, a char containing iron equivalent to the amount of sulphur originally existing as calcic sulphate on beginning the round. The iron will snatch the sulphur from the calcium in the event of the reduction of calcic sulphate, and no amount of routine sugar-house treatment will ever remove *ferrous* sulphide. It is quite permanent.

Between the two varieties occur many gradations. Some samples contain little or no FeS, and a large percentage of calcium sulphides; more are of the permanent variety, and have *no* calcium sulphides present.

These statements are founded upon the sure ground of experiment, and Mr. Murphy must supply experiments in refutation.—I am, &c.

R. Frazer Smith.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 17, October 26, 1874.

Composition and the Physiological Properties of Coal-Tar.—M. Dumas.—The author examines coal-tar with reference to its power of destroying insects, and especially the phylloxera. He finds that its efficacy lies in the volatile constituents, and especially in the hydrocarbons boiling below 180°.

Eighth Note on the Electric Conductivity of Bodies of Medium Conducting Power.—Th. du Moncel.—In this paper the author examines the conducting power of tissues, which, being all more or less hygroscopic, yield very different results, according to the amount of moisture in the air, the hour of the day, and the temperature. In performing these experiments the specimens of tissues under examination have been interposed between two platinum electrodes, so that the resistance would be represented by their thickness. Silks and woollens gave unexpected results, for in all experiments made with a relatively low degree of moisture (36° of the hair hygrometer), woollens showed less conductivity than silk. Black silks caused the galvanometer to deviate sometimes 40°, whilst coloured silks left it unaffected. The dearest blacks produced the smallest deviation. It follows from these experiments that silks supposed to be insulators are not so; and in dry weather woollens are superior as insulators, at least as regards voltaic currents. The apparent results of colour become intelligible when we learn that most black silks are *weighted*, *i.e.*, saturated with certain matters which combine with the silk, and increase its weight to the extent sometimes of 300 per cent. In the better class of silks the weighting ranges from 10 to 60 per cent. This increase of weight is generally produced by passing the silks alternately through baths of iron and of tannin. Hence such silks are covered with a hygroscopic and conductive layer. With coloured silks this practice does not prevail, as the manufacturers have not succeeded in weighting them beyond, at the outside, 10 per cent. The author raises the interesting question whether the electro-conductivity of black silks might not furnish an approximate method of determining the degree of adulteration, care being taken to experiment at a constant temperature and degree of moisture? Linens absorb moisture from the air the most eagerly, and give the widest deviations. Cottons conduct well, though less perfectly than linens. The galvanometric indications are so precise for different kinds of woven tissues that it is possible by this means to detect silk or woollen stuffs mixed with cotton or linen. Thus common orléans (wool and cotton) gave a deviation of 7°, whilst wool gave 0°, and jaconet of the same thickness 13°. The effects of polarisation are less distinct with tissues than with mineral bodies. As with feeble conductors they always present effects very different, according to the direction of the currents, the author was induced to make a series of special experiments, taking minerals as a starting-point. These experiments have presented the phenomenon of polarisation under a new light. It may, in fact, happen in these conditions that for a certain direction of the current of the battery the effects of polarisation occasion a successive augmentation of the intensity of the current, whilst for the opposite direction they occasion a considerable and very rapid diminution. It may even happen that the current remains invariable in spite of an energetic polarisation; and, what is still more curious, the current of polarisation after the interruption of the current of the battery is more considerable in the first case than in the second. These effects are especially manifested in siliceous minerals.

Fermentation of Apples and Pears.—MM. G. Lechartier and F. Bellamy.—In a memoir presented to the Academy in November, 1872, the authors made known the results of experiments, showing that carbonic acid and alcohol originate in fruits kept in closed vessels, and secluded from the oxygen of the air, without the possibility of finding an alcoholic ferment in their interior. M. Pasteur deduces from his theory of fermentation the conclusion that the formation of alcohol is due to the continuation of the physical and chemical life of the fruit cells in new conditions, similar to those of the cells of ferments. Experiments on various fruits, carried on by the authors during the years 1872, 1873, and 1874, give results which the authors regard as a demonstration of this view.

Absorption of Gas by Iron Wires Re-heated to Redness and Quenched in Dilute Sulphuric Acid.—M. D. Sevoz.—In wire-drawing, when the maker has arrived at a certain gauge, he is obliged, in order to draw the wire finer, to re-heat to redness in cast-iron stoves, closed as hermetically as possible, and then to quench in water containing 2·3 per cent of monohydrated sulphuric acid. It often happens that iron wire which has undergone these two operations, for instance, at No. 18 (34-10ths of a millimetre), becomes brittle when it has reached No. 8 (13-10th). If the wire is broken, and the fracture plunged into a glass of water, rapid and numerous bubbles of gas are seen to escape. The author has collected this gas, mixed it with air, and obtained a distinct explosion, but has not been able to decide whether it is carbonic oxide or hydrogen. The presence of a small quantity of this gas renders the metal brittle. When the wire-drawers meet with pieces of brittle wire they ascertain, by putting saliva upon the fracture, whether the brittleness is due to gas. If this is the case they lay the wire aside for five to eight days, when the gas is found to have disappeared, and the wire resumes its ordinary malleability.

Isomerism of Perbromide of Acetylen and Tetra-Bromated Hydride of Ethylen.—M. E. Bourgoin.—The author's experiments establish the isomerism of these two bodies.

Decomposition of Certain Salts by Water.—M. A. Ditte.—In this paper the author examines the decomposition of the nitrate of bismuth, $BiO_3,3NO_5,3HO$; the subnitrate, BiO_3,NO_5,HO; and the sesquichloride of antimony in contact with water. He finds that the subnitrate of bismuth, in contact with boiling water, is decomposed until the water contains about 4·5 grms. of free acid per litre. On exhausting this salt with boiling water we obtain a new basic nitrate, answering to the formula $2BiO_3,NO_5$, and having no marks of cystallisation.

On Electro-Magnets.—M. Deleuil.—The author, making investigations on the method of removing from the "slip" destined for the manufacture of porcelain the particles of iron which they contain, substituted electro-magnets for the permanent magnets previously employed. As, however, they require to be continually plunged into the slip, it is necessary to secure the electro-magnet against the penetration of the liquid into the coil. He constructed an electro-magnet, of which the middle and the two extremities are of iron, as well as the exterior armature, which covers the coil only in part. The two extremities of this armature are separated by a ring of brass, representing about the third of its length. The folds of the helix are perfectly secure, and during the passage of the current a magnetic mass is obtained, which readily withdraws all particles of iron from the slip.

Liebig's Annalen der Chemie und Pharmacie,
September 19, 1874.

Ludwigit—a New Mineral from Banat.—G. Tschermak.—Specimens of this mineral have been recently brought from Morawitza. It consists of fine, generally parallel fibres, whence recent specimens have a silky lustre. The colour is blackish green, but there is a modification almost black with a violet cast. It is very tough, and the fibres are not easily separated from each other. They are sometimes 8 centimetres in length. The mineral is accompanied by magnetite in the shape of small grains, which intersect the mass in threads and veins. Granules of calcite are also met with. In hardness the mineral is equal to apatite. Its sp. gr. ranges from 3·907 to 4·016. The streak is blackish green, but paler than the mass. The finest fragments, when examined under a power of 200 diameters, are transparent, with a greenish brown colour. Its composition is—

Boracic acid	16·09
Oxide of iron	39·92
Protoxide of iron	12·46
Magnesia	31·69
	100·16

Glycerin Ether.—V. von Zotta.—Not adapted for abstraction.

Conversion of Benzol-Disulph-Acid into Terephthalic Acid.—R. Fittig.—The author maintains, in opposition to Prof. Barth, that benzol-disulph-acid yields only terephthalic acid, and not a trace of isophthalic acid.

Structure of Pinacolin.—A. Butlerow.—A hypothetical paper.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 7, 1874.

Dilatations due to Electricity.—M. H. Streintz has made a series of experiments on the increment of length in bars of different metals traversed by electric currents. He finds that the galvanic current produces no other modification in the elasticity of a conducting wire than that caused by the rise of temperature occasioned. Under the influence of a current a conductor expands more than if it had been raised to the same temperature without the current. To this rule tempered steel forms the only exception. Galvanic expansion does not show itself immediately when the circuit is made, but gradually like the expansion occasioned by heat. Galvanic expansion does not appear to be the consequence of an electro-dynamic repulsion, but results rather from a polarisation of heat, or a change of direction of the calorific vibrations.

Falsification of Sugars.—The *Journal des Fabricants de Sucre* strongly denounces the fraudulent applications of caramel in the French sugar trade.

Reagent for Arsenic.—Prof. Hager recommends the following method for detecting arsenic in the colours of paper-hangings:—A little of the paper is steeped in a concentrated solution of nitrate of soda, obtained by dissolving this salt in a mixture of equal parts alcohol and water, and letting it dry. Then the paper is burnt upon a porcelain saucer. The combustion generally takes place quietly and without flame. Water is poured upon the ashes, potash in excess is added, and the whole boiled and filtered. Dilute sulphuric acid is added, and then permanganate of potash, which is added gently as long as the red colour disappears and give place to a yellow under the influence of heat. If the liquid becomes turbid it is filtered anew. It is let cool, and more dilute sulphuric acid added, and a small plate of pure zinc. This should be done in a flask, which is then stoppered with a cork having two slits. In one of these is placed a slip of paper, steeped in a solution of nitrate of silver; in the other, a piece of parchment moistened with sugar of lead. If arsenic is present the silver paper blackens. The lead paper only serves to detect sulphide of hydrogen.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 10, October, 1874.

Report on the System of Apparatus for Lighting the Gas Burners in the Hall of the National Assembly at Versailles.—M. Lissajous.—The burners are lighted by electricity. A Ruhmkorff coil of medium size, with an automatic mercurial interruptor, is set in action by a Leclanché battery of four elements, the zincs having a surface of 4 square decimetres. These are only equivalent to three Bunsen elements of a middle size, but their duration is much greater. Under the influence of this battery the coil gives sparks of 15 centimetres. To transmit the electricity to the different lustres a special wire is employed for each, but the return current passes through one common wire.

Utilisation of the Sewage Water of Paris.—M. Durand-Claye.—A lecture on the methods of dealing with sewage. He enumerates three—filtration, precipitation, and irrigation. The first he pronounces impossible. Of the second he speaks only in its crudest form, with sulphate of alumina alone. He pronounces it, however, to have given excellent results. Of irrigation he treats at some length, without, however, pointing out any method of meeting or escaping its serious difficulties.

MISCELLANEOUS.

The Royal Society.—The following is the list of the new Council elected at the anniversary meeting of the Society on the 30th ult. *President:* J. D. Hooker, C.B., M.D., D.C.L., LL.D. *Treasurer:* W. Spottiswoode, M.A., LL.D. *Secretaries:* Professor G. G. Stokes, M.A., D.C.L., LL.D.; and Prof. T. H. Huxley, LL.D. *Foreign Secretary:* Prof. A. W. Williamson, Ph.D. *Other Members of the Council:* Prof. J. C. Adams, LL.D.; the Duke of Devonshire, K.G., D.C.L.; John Evans, Pres. G.S., F.S.A.; Capt. Frederick J. O. Evans, R.N., C.B.; Albert C. L. G. Günther, M.A., M.D.; Daniel Hanbury, Treas. L.S.; Sir John Hawkshaw, M.I.C.E.; Joseph Norman Lockyer, F.R.A.S.; Robert Mallet, C.E., M.R.I.A.; Nevil S. Maskelyne, M.A.; C. W. Merrifield, Hon. Sec. I.N.A.; Prof. E. A. Parkes, M.D.; Right Hon. Lyon Playfair, C.B., LL.D.; A. C. Ramsay, LL.D.; Major-General Sir H. C. Rawlinson, K.C.B.; and J. Burdon Sanderson, M.D.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of manures, and in the apparatus employed therein. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Henri Antoine Prosper Lissagaray, chemist, Pantin, France.) March 11, 1874.—No. 885. This invention relates to the production of manure by the precipitation, in a solid and imputrescible form, whilst retaining its property of assimilation of the nitrogenous matter contained in solution in blood; and to the apparatus employed for that purpose, which apparatus is also applicable to the manufacture of other manures. In carrying out this invention it is proposed to effect the precipitation by means of mineral acids, such, for example, as sulphuric acid or chlorhydric acid; or of compounds, such, for example, as sulphate of alumina or sulphate of iron, or the two combined, which are mixed with the liquid blood, into which there has been previously introduced a soluble salt or compound, such, for example, as an alkaline sulphite or bisulphite, or alkaline earth; or in lieu therof, chloride of lime or other hypochlorite; the liberation of one of the constituent elements, say, for example, sulphurous acid or chlorine, by means of the acid or body having an acid reaction subsequently introduced into the liquid, effecting, by a reaction produced from molecule to molecule throughout the whole mass, the complete coagulation of the solid matter in the blood, and at the same time rendering such coagulated matter imputrescible. The precipitated matter is collected in any suitable filtering apparatus, and either pressed into the form of cakes, or dried in any suitable manner. The apparatus consists of two series of vessels, through which the blood and acid are respectively conducted to a common vessel below, in which their admixture is effected. These vessels are provided with suitable ball and other cocks for the purpose of obtaining a continuous and proportional discharge of the liquids, and of intercepting them as required.

Improvements in the treatment of the liquors used in scouring or cleaning wool. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, Middlesex. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès Schaerbeek, Brussels.) March 13, 1874.—No. 913. The object of this invention is, first, to extract the potash in a state of carbonate, which is its most valuable condition, by a process which is at once economical and expeditious; and, secondly, to completely extract the greasy matters which separate from the washing liquors. The process consists in the employment either of caustic baryta or strontia, the essential characters of which are, first, to effect the entire separation of the greasy matter; secondly, to extract the carbonate of potash contained in the washing liquors; and, thirdly, to effect the continuous revivification of the baryta and strontia employed.

Improvements in the manufacture of prussiate of potash and prussiate of soda, and in the means employed for collecting and utilising the gases and other substances emitted in the manufacture thereof. Samuel Nield and Benjamin Foster, both of Leeds, York. March 13, 1874.—No. 914. Materials are placed in iron retort and burnt as usual. Gases and other matters are conveyed into a receiver containing "liquor," consisting of alkali, acid, water, or their equivalents; a deposit of animal colouring matter and potash being left is used again, or employed for dyeing or otherwise. The gases may be used for illumination purposes.

NOTES AND QUERIES.

Tanning Rabbit's Skins.—Will you be kind enough, or any of your correspondents, to let me know the best way of tanning rabbit's skins, &c., with the fur on, as I am a great sportsman, and would like to know how to convert the gelatin of the skin into leather? Would a solution of tannic acid do?—D. Lennard.

MEETINGS FOR THE WEEK.

Saturday, Dec. 5th.—Physical, 3. "On a Strophometer," by T. Hearson; "On a Method of Demonstrating the Expansion of Solids," by Prof. G. C. Foster; "On the Electrolysis of certain Metallic Salts," by Dr. J. H. Gladstone and Mr. A. Tribe.
Monday, 7th.—Society of Arts, 8. Cantor Lectures. "Alcohol: its Action and its Use," by Dr. B. W. Richardson, F.R.S.
— Royal Institution, 2. General Monthly Meeting.
— Medical, 8.
Tuesday, 8th.—Civil Engineers, 8.
— Photographic, 8.
Wednesday, 9th.—Society of Arts, 8. "On the Protection of Buildings from Lightning," by Dr. R. J. Mann.
Thursday, 10th.—Royal, 8½.
— Royal Society Club, 6½.
— Society of Arts. Conference to discuss "The Steps to be taken to insure prompt and efficient measures for Preventing the Pollution of Rivers." The chair will be taken at 3 o'clock by the Right Hon. Lyon Playfair, C.B., M.P., F.R.S.
Friday, 11th.—Quekett Club, 8.

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GEO. ASHFORD, Secretary.

King Edward's School, Birmingham,
26th November, 1874.

Royal School of Mines Club.—The Second ANNUAL DINNER will take place on Monday, December 21st. Past and present Students intending to dine are requested to apply for particulars to the Hon. Sec., Royal School of Mines Club, 28, Jermyn Street, S.W.

PATENTS.—Mr. Vaughan, F.C.S., British Foreign, and Colonial PATENT AGENT. Special attention given to Inventions relating to Chemistry, Mining, and Metallurgy. "Guide to Inventors" Free by Post.—Offices, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

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THE CHEMICAL NEWS.

Vol. XXX. No. 785.

THE CONSTITUTION OF MUREXIDE.

By JAMES REOCH, M.A., M.B.

In the Chemical News, vol. xxx., p. 179, I described some new facts in regard to murexide. The present paper is a continuation of these researches.

Prout was the first to regard murexide as the ammonium salt of a peculiar acid, which he named purpuric acid. Liebig denied the existence of this acid, and regarded murexide as an amide; but for many years chemists have reverted to Prout's view, on the double ground that murexide gives off NH_3 when treated with cold potash, and that other purpurates exhibit characteristic colours. My own experiments, however, are entirely in favour of Liebig's view. Gregory showed that, when 7 parts of alloxan and 4 parts of alloxantin were boiled in 240 parts of water, and added to 80 parts of amm. carb., murexide was abundantly produced. I have never failed to procure it in this manner, not only when amm. carb. was used, but with other ammoniacal salts, as the benzoate, oxalate, phosphate, and valerianate; from all these crystals of murexide are readily produced, and a deep pink colour with the sulphate, bromide, chloride, and iodide, though not the beautiful prismatic crystals.

The first objection, therefore, I would start to the purpurate theory is, that if purpurate of potash or soda be entirely analogous to murexide, how comes it that no colour is produced by adding this mixture of alloxantin and alloxan to a salt of potash or soda? I have tried sixteen salts of potash and thirteen of soda, and, though a reaction takes place in some of them—for the bicarbonates give off gas, and a precipitate is formed of long needles, different from alloxantin crystals, and similar in appearance to the needles of uric acid seen in very acid urines—yet the fluid and precipitate are colourless. I have examined more than 100 salts of different metals, chiefly pharmacopœial, and in none of them is there a precipitate analogous to murexide produced by the above mixture.

It is held, however, that the violet or indigo-blue colour produced by adding KHO to murexide shows that KHO displaces NH_3, and forms purpurate of KHO; but let any one put 5 m.grms. of murexide on a series of glass slides, and add a drop of water, of NH_3, of soda, and of potash, and examine microscopically, and he will find that in the first there is a slight pink tinge and the crystals are little affected; with the others there is a violet colour, in ascending depth and corresponding completeness of solution of the crystals. In fact, this small quantity of murexide, which is entirely dissolved in a drop of liq. potass., would require 12 c.c. of distilled water to dissolve it; for I find that murexide requires 2000 to 2500 parts of cold water for solution, and, though much more soluble in boiling-water, it is still more soluble in cold KHO.

It is scarcely fair, therefore, to compare the solution of murexide in water to that in potash. It will, however, be said that, even if the solutions be correspondingly diluted, yet the tint is different, the potash solution being violet and the other pink; but it must be remembered that the crystals have a double colour, being of a shining green on two of their faces, and of a red-brown on the other two, and that this violet tint, appearing when each of the three alkalies, NH_3, NaHO, and KHO, are added to murexide, and being deeper with soda than with NH_3, and deepest with KHO, corresponding with the solubility of murexide in these alkalies, it would seem much more likely that the violet tint depends on the peculiarly intimate nature of the solution, than on any substitution of KHO for NH_3; for how otherwise could the violet tint produced by adding NH_3 be explained, since it is evident that NH_3 cannot replace NH_3? If this theory be true, it would follow that no proof exists that cold KHO causes the evolution of NH_3 from murexide, for it cannot be detected by test-paper, but is a mere inference from the fact that the violet colour is produced in the cold. Further, when acetic acid is added to the violet KHO solution, it restores the pinkish red colour of murexide. It is difficult to see how this could be if KHO displaced the NH_3 and formed a new salt, but it is easily accounted for if the KHO be merely the agent of dissolving the murexide. Again, if murexide be boiled with KHO, at least one equivalent of NH_3 is rapidly given off, but the purple colour is at the same time destroyed and changed to pale yellow. It is hard to account for this on the purpurate theory, for murexide is not very unstable; it requires some weeks for a dilute solution to decompose, and it may be boiled for a considerable time without injury. If, therefore, KHO displaced NH_3 in the cold and formed a new salt, one would expect that the latter would be more stable, and yet a considerable quantity can be decolorised in two or three minutes. The fact is, boiling with NH_3, as well as NaHO and KHO, will destroy the colour of murexide and accelerate its decomposition, even in the cold; but it is improbable that this is caused by the substitution of NH_3, else NH_3 itself should have no influence.

Having stated these objections to the existence of purpurate of potash, I need not examine particularly the other so-called purpurates, but will merely state two causes which may have led to a belief in their existence. First, the varying nature of the crystals of murexide itself; their general form is prismatic, but they also occasionally assume the globular and other forms, and, indeed, are little inferior to uric acid itself in point of diversity of microscopical appearance. Secondly, alloxantin is a chief product of the decomposition, as well as formation, of murexide, as I showed in my former paper, and this body, whose reactions are so little understood, is the source of some coloured salts. Thus it gives an intense violet precipitate with baryta- or lime-water, and along with soda produces a blue colour with ferric chloride, which is little inferior in delicacy to sulphocyanide of potassium as a test for iron; with liq. bismuthi it gives a deep yellow, and with acid molybdate of ammonium a deep blue. It might, therefore, happen that some of the salts of alloxantin were mistaken for salts of purpuric acid. It is easier, however, to establish a negative conclusion as to what murexide is not, than to ascertain positively what it is. As I said before, I get it by adding a mixture of alloxan and alloxantin to the benzoate, carbonate, oxalate, phosphate, and valerianate of ammonia, slightly from the sulphate, and a colouration only from the bromide, chloride, and iodide; but, as Gregory long ago remarked, neither alloxan nor alloxantin give so much separately as the two combined—thus, by adding 100 m.grms. of alloxantin to 175 m.grms. of alloxan, I have obtained 64 to 85 m.grms. of murexide, but only 1 to 2 m.grms. from the same quantity of either separately.

I may here say that I do not make these estimates by weight, as other precipitates might be produced, but by comparing the intensity of the colour when dissolved in a large quantity of water with that produced by a given quantity of pure murexide. The fact that so much alloxantin produces such an insignificant quantity of murexide, and that what it does produce is decolourised in a few days, shows clearly that the ordinary theory expressed by the equation—

$$\overset{\text{Alloxantin.}}{C_8H_4N_4O_7} + 2NH_3 - H_2O = \overset{\text{Murexide.}}{C_8H_8N_6O_6},$$

cannot be maintained; neither will alloxan alone account for its formation; and even the mixture of the two does not give more than a third of the quantity one might expect, if any simple equation were true. Moreover, aqueous alloxan alone will turn pink on standing, so that it contains the elements of decomposition within itself; and so, also, will dry alloxantin exposed to the atmosphere. From uric acid, evaporated with nitric acid, not above $\frac{1}{19}$th of its weight of murexide, at the most, can be recovered; and though I have not examined dialuramide, and other bodies capable of producing murexide, it is evident that, if a weight of murexide is not produced corresponding to the quantity of material used, the equations ordinarily given must be entirely hypothetical.

Further, no two analyses of murexide agree, and the ordinary formula is not derived from any analysis or combination of analyses, but from supposed views of its formation from different bodies. I have made several combustions of some commercial murexide which appeared very pure when examined microscopically. The mean of four experiments, as to C and H, gave 29·8 and 2·5, respectively; while five determinations of the N, by volumetric analysis, gave a mean of 31·2. I am, therefore, disposed to propose a new formula for murexide.

	Calculated.	Experiment.
C_{10}	30·0	29·8
H_{10}	2·5	2·5
N_9	31·5	31·2
O_9	36·0	36·5
	100·0	100·0

It may be urged that this formula does not explain its formation; but, when we are still ignorant of the rational formula of uric acid, and are absolutely ignorant as to the mode of its formation, it may well be supposed that the arrangement of atoms in murexide may long be undiscovered. At any rate, it seems better to rely on the result of the combustion-tube, than on a congeries of hypotheses as to its nature and reactions.

SOME REMARKS ON DALTON'S FIRST TABLE OF ATOMIC WEIGHTS.*

By Professor HENRY E. ROSCOE, F.R.S.

As the Society is aware, the first table, containing the relative weights of the ultimate particles of gaseous and other bodies, was published as the 8th and last paragraph to a paper by Dalton, "*On the Absorption of Gases by Water and other Liquids*," read before this Society on October 21, 1803, but not printed until the year 1805. There appears reason to believe these numbers were obtained by Dalton after the date at which the paper was read, and that the paragraph in question was inserted at the time the paper was printed. The remarkable words with which he introduces this great principle give us but little clue to the methods which he employed for the determination of these first chemical constants, whilst in no subsequent publication, as in none of the papers which have come to light since his death, do we find any detailed explanation of how these actual numbers were arrived at. He says,† "I am nearly persuaded that the circumstance" (viz. that of the different solubilities of gases in water) "depends upon the weight and number of the ultimate particles of the several gases—those whose particles are lightest and single being less absorbable, and the others more, according as they increase in weight and complexity. An inquiry into the relative weights of the ultimate particles of bodies is a subject, so far as I know, entirely new. I have been lately prosecuting this enquiry with remarkable success. The principle cannot be entered upon in this paper; but I shall just subjoin the results, as far as they appear to be ascertained by my experiments."

Here follows the table of the relative weights of the atoms:—

Table of the Relative Weights of the Ultimate Particles of Gaseous and Other Matters.

Hydrogen	1
Azote	4·2
Carbon	4·3
Ammonia	5·2
Oxygen	5·5
Water	6·5
Phosphorus	7·2
Phosphuretted hydrogen	8·2
Nitrous gas	9·3
Ether	9·6
Gaseous oxide of carbon	9·8
Nitrous oxide	13·7
Sulphur	14·4
Nitric acid	15·2
Sulphuretted hydrogen	15·4
Carbonic acid	15·3
Alcohol	15·1
Sulphurous acid	19·9
Sulphuric acid	25·4
Carburetted hydrogen from stagnant water	6·3
Olefiant gas	5·3

In the second part of his "New System of Chemical Philosophy," published in 1810, Dalton points out under the description of each substance the experimental evidence upon which its composition is based, and explains, in some cases, how he arrived at the relative weights of the ultimate particles in question. Between the years 1805 and 1810, however, considerable changes had been made by Dalton in the numbers; the table found in the first part of the New System being not only much more extended, but in many cases the numbers differing altogether from those given in the first table published in 1805. It is therefore, unfortunately, to a considerable extent now a matter of conjecture how Dalton arrived at the first set of numbers. All we know is that it was mainly by the consideration of the composition of certain simple gaseous compounds of the elements that he arrived at his conclusions, and in order that we may form some idea of the data he employed we must make use of the knowledge which chemists at that time (1803-5) possessed concerning the composition of the more simple compound gases.

As I can find no record of any explanation of these early numbers, I venture to bring the following attempt to trace their origin before the Society to whom we owe their first publication.

The first point to ascertain, if possible, is how Dalton arrived at the relation between the atomic weights of hydrogen and oxygen given in the table as 1 to 5·5 (but altered to 7 in 1808). The composition of water by weight had been ascertained by the experiments of Cavendish and Lavoisier to be represented by the numbers 15 of hydrogen to 85 of oxygen, and the result was generally accepted by chemists at the time, amongst others doubtless by Dalton. That in those early days Dalton had actually repeated or confirmed these experiments appears improbable. At any rate he formed the opinion that water was what he called a binary compound, *i.e.*, that it is made up of one atom of oxygen and one atom of hydrogen combined together. Hence if he took the numbers 85 to 15 as giving the composition of water, the relation of hydrogen = 1 to oxygen would be as 1 to 5·6, or nearly that which he adopted. It does not appear possible to explain why Dalton adopted 5·5 instead of 5·6 for oxygen; it may perhaps have been a mistake or a misprint, as there are two evident mistakes in the table, viz., 13·7 for nitrous oxide instead of 13·9, and 9·3 for nitrous gas instead of 9·7.

Let us next endeavour to ascertain how he obtained the number 4·3 for carbon (altered to 5 in 1808 and 5·4 later on). Lavoisier, in the autumn of 1783, had ascertained the composition of carbonic acid gas by heating a given weight of carbon with oxide of lead, and he came to the conclusion that the gas contained 28 parts by weight of carbon to 72 parts by weight of oxygen. Now Dalton was not only acquainted with the properties and composition of carbonic acid, but he was aware that Cruikshank had shown in 1800 that the only other known compound of carbon and oxygen, carbonic oxide gas, yields its own bulk of carbonic acid when mixed with oxygen and burnt; and also that Desormes[*] analysed both these gases, finding carbonic oxide to contain 44 of carbon to 56 of oxygen, whilst carbonic acid contained to 44 of carbon 112 of oxygen, being just double of that in the carbonic oxide. Dalton adds "this most striking circumstance seems to have wholly escaped their notice." Hence Dalton assumed that one atom of carbon is united in the case of carbonic oxide with one atom of oxygen, whilst carbonic acid possessed the more complicated composition and contains two atoms of oxygen to one of carbon. Now if carbonic acid contains carbon and oxygen in the proportion of 28 to 72, carbonic oxide must contain half as much oxygen, viz., 28 of carbon to 36 of oxygen, and assuming that the atomic weight of oxygen is 5·5 that of carbon must be

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* A paper read before the Manchester Literary and Philosophical Society, November 17, 1874.

† "Manch. Mem.," vol. i., 2nd Series, p. 286.

$$\frac{28 \times 5{\cdot}5}{36} = 4{\cdot}3.$$

Having thus arrived at the number 4·3 as the first atomic weight of carbon, it is easy to see why Dalton gave 6·3 as the atomic weight of carburetted hydrogen from stagnant water, and 5·3 as that of olefiant gas. The one represents 1 atom of carbon to 2 of hydrogen, the other 1 of carbon to 1 of hydrogen, or olefiant gas contains two equal quantities of carbon, only half as much hydrogen as marsh gas. This conclusion doubtless expressed the results of Dalton's own experiments upon these two gases which were made, as we know from himself, in the year 1894. He proved that neither of these gases contained anything besides carbon and hydrogen, and ascertained—by exploding with oxygen in a Volta's eudiometer—that if we reckon the carbon in each the same, then carburetted hydrogen contains exactly twice as much hydrogen as olefiant gas does, and that "just half of the oxygen expended on its combustion was applied to the hydrogen and the other half to the charcoal. This leading fact afforded a clue to its constitution." Whereas, in the case of olefiant gas, two parts of oxygen are spent upon the charcoal and one part upon the hydrogen.

The atomic weight of nitrogen (azote = 4·2) was doubtless obtained from the consideration of the composition of ammonia, whose atomic weight is given in the table at 5·2. Ammonia was discovered in 1774 by Priestley, but the composition was ascertained by Berthollet in 1775, by splitting it into its constituent elements by means of electricity, when he came to the conclusion that it contained 0·193 part by weight of hydrogen to 0·807 part by weight of nitrogen. Dalton assumed that this substance is a compound of one atom of hydrogen with one of nitrogen, and hence he obtained for the atomic weight of azote

$$\frac{807 \times 1}{193} = 4{\cdot}2\,;$$

and 4·2 + 1 = 5·2 as the atomic weight of ammonia. It is also probable that Dalton made use of the composition of the oxides of nitrogen for the purpose of obtaining the atomic weight of nitrogen. If we take the numbers obtained partly by Davy and partly by himself, as given on page 318 of the "New System," as representing the composition of the three lowest oxides, it appears that the mean value for nitrogen is 4·3 when oxygen is taken as 5·5. In all probability the number in this table (4·2) was obtained from an experiment of Dalton's made at an earlier date.

It is not possible to ascertain the exact grounds upon which Dalton gave the number 7·2 for phosphorus; its juxtaposition, however, in the table to phosphuretted hydrogen shows that it was probably an analysis or a density determination of this gas which led him to the atomic weight 7·2, under the supposition that this gas (like ammonia) consisted of one atom of each of its components. In the second table, published in 1808, Dalton gives the number 9 as that of the relative weight of the phosphorus atom, and we are able to trace the origin of this latter number, although that of 7·2 is lost to us. On p. 460, Part II. of his "New System," Dalton states that he found 100 cubic inches of phosphuretted hydrogen to weigh 26 grains, the same bulk of hydrogen weighing 2·5 grains; hence, assuming that equal volumes contain an equal number of atoms, we have

$$\frac{26 - 2{\cdot}5}{2{\cdot}5} = 9{\cdot}4$$

gives the atomic weight of phosphorus nearly. It was probably by similar reasoning from a still more inaccurate experiment than this one that he obtained the number 7·2.

Sulphur, which stands in the first table of 1803 at 14·4, was altered in the list published in the "New System" to 13. These numbers were derived from a consideration (1) of the composition of sulphuretted hydrogen, which he regarded as a compound of one atom of sulphur with one of hydrogen, and (2) of that of sulphurous acid, which he supposed to contain one atom of sulphur to two of oxygen. Dalton knew that the first of these compounds contained its own volume of hydrogen, and he determined its sp. gr., so that by deducting from the weight of one volume of the gas that of one volume of hydrogen, he would obtain the weight of the atom of sulphur compared to hydrogen as the unit. The sp. gr. he obtained was about 1·23 (corresponding nearly he says—p. 451—to Thenard's number 1·23); hence (as he believed air to be 12 times as heavy as hydrogen) he would obtain the atomic weight of sulphur as (12 × 1·23) − 1 = 13·76, which number, standing half way between 14·4 as given in the first table and 13 as given in the second, points out the origin of the first relative weight of the ultimate particle of sulphur. So from sulphurous acid he would obtain a similar number, taking the sp. gr. as obtained by him (Part II., 389) to be 2·3, and remembering that this gas contains its own bulk of oxygen (p. 391), he obtained (2·3 − 1·12) × 12 = 14·16 for the atomic weight of sulphur. As, however, we do not possess the exact numbers of his sp. gr. determinations, and as we do not exactly know what number he took at the time as representing the relations between the densities of air and hydrogen (in 1803 he says that the relation of 1 : 0·077 is not correct, and that $\frac{1}{13}$ is nearer the truth) it is impossible to obtain the exact numbers for sulphur as given in the first table.

In reviewing the experimental basis upon which Dalton founded his conclusions, we cannot but be struck with the clearness of perception of truth which enabled him to argue correctly from inexact experiments. In the notable case, indeed, in which Dalton announces the first instance of combination in multiple proportion[*] the whole conclusion is based upon an erroneous experimental basis. If we repeat the experiment as described by Dalton we do not obtain the results he arrived at. Oxygen cannot as a fact be made to combine with nitric oxide in the proportions of one two by merely varying the shape of the containing vessel, although by other means we can now effect these two acts of combination. We see, therefore, that Dalton's conclusions were correct, although in this case it appears to have been a mere chance that his experimental results rendered such a conclusion possible.

ACTION OF LIGHT ON CERTAIN VANADIUM COMPOUNDS.[†]

By JAMES GIBBONS.

Potassium divanadate, in combination with organic matter, is first rendered green, and ultimately blue by exposure to light, being reduced probable to the state of vanadium tetroxide. The salt is not sensitive to light in the absence of organic matter.

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[*] *Ann de Chimie*, T. 39, p. 38.

[*] "Manch. Mem.," vol. 1, 2nd series, p. 250.

[†] A Paper read before the Manchester Literary and Philosophical Society, November 17, 1874.

Gelatine mixed with potassium divanadate, becomes slightly less soluble in warm water after being exposed to light; this is apparent by the unexposed portions of the film swelling and dissolving more quickly when treated with water than the exposed parts.

If a colourless film of dry sodium orthovanadate (Na_3VO_4) free from organic matter, be exposed on glass to the sun for several hours, it only acquires a faint brown tint. The film kept in the dark with access of air for some hours, regains its normal colourless condition. The salt does not undergo any change when exposed to diffused daylight.

Paper, which does not contain any size of an animal origin, when coated with a solution of sodium orthovanadate, is darkened on exposure to light, the depth of tint depending on the length of exposure and on the strength of the solution used. The tint, however, never becomes darker than a slate colour.

If the paper thus prepared be immersed, after exposure to light, in a solution of silver nitrate, the colour in the exposed part instantly changes to a deep brown or to a black colour, varying according to the amount of exposure. A tint of the decomposed vanadate, which is of so slight an amount as to be with difficulty distinguished from the whiteness of the paper, will, by immersion in the silver nitrate, be toned so as to exhibit a very perceptible tint.

It is evident that paper prepared in this way might be employed for the purposes of photographic printing.

The unexposed parts are converted by treatment in the silver bath, into yellow silver vanadate. This substance may be dissolved out either by ammonia or by sodium hyposulphite. This act of fixing converts the dark brown or black part into those of a red colour. This may be prevented to some extent by using a bath of ammonio-silver nitrate, with an excess of ammonia, instead of the simple silver nitrate bath. The developed print can afterwards be toned with gold chloride.

The length of exposure required to produce a deep black is about one hour to a strong sunlight. This by using a solution of the sodium orthovanadate containing about 11 per cent of the salt.

Some ligneous substance only must be present with the sodium orthovanadate for the production of the above-mentioned slaty tint; for if an albuminous body be present, a faint brown tint is produced after exposure to light, and the silver nitrate is not afterwards reduced to any very great extent. The slate colour of the reduced salt appears to be due to the formation of vanadium trioxide. If the exposed paper be kept for some weeks its colour changes to that of a yellowish brown, free vanadic acid appearing to be produced.

Gelatine impregnated with sodium orthovanadate exposed to light, and afterwards dipped into a solution of silver nitrate, becomes insoluble in hot water.

Silver orthovanadate is capable of forming a photographic image, which is nearly latent, and which may be developed by the ordinary ferrous developer used in photography.

To produce this image two or three minutes' exposure to sunlight is required. To develope it, it is essential that little or no silver nitrate be present; otherwise, the exposed and unexposed parts are reduced indiscriminately. The washed silver vanadate can be mixed with a solution of gelatine containing a little albumen, spread upon paper, and allowed to dry; it can then be exposed to light, and afterwards developed.

Alteration of Coal by Prolonged Exposure to Moist Air.—M. Varrenstrass finds that the loss of weight due to slow oxidation, and to the escape of gases rich in carbon, may amount to one-third of the original weight. The calorific power sustains in this case a loss of 47 per cent. In closed store-houses the loss of weight was only 25 per cent, and that of heating-power 10 per cent. Bituminous coals undergo the most rapid alteration.—*Les Mondes.*

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of the members of this Society was held on Tuesday, December 1st, at the City Terminus Hotel, Cannon Street, under the presidency of Professor Redwood.

The minutes of the previous meeting were read by the Secretary. A brief report was presented, stating what had been done by the Provisional Committee appointed at the Inaugural Meeting in August last, from which it appeared that the actual number of original members of the Society is now 63, only about fifteen public analysts throughout the kingdom having failed to avail themselves of the opportunity of joining without election. Since the beginning of October ten meetings had been held, the principal business transacted being the drawing up of a constitution for the Society, and the framing a definition of adulteration which should be at once comprehensive enough to include all actual adulterations, and at the same time sufficiently elastic to prevent oppression or injustice. To this end a great number of proposed definitions, submitted by some of the most eminent chemists in the kingdom, had been carefully considered and digested, and they had also been laid before experienced solicitors connected with local authorities whose legal experience, it was thought, would be valuable. The result had been circulated amongst the members in a printed form, but several suggestions had been received since, which appeared worthy of consideration before the proposed definition was adopted. The remainder of the report referred to the election of officers for the ensuing year, and the financial arrangements of the Society; also to a contemplated arrangement with the editor of an established scientific journal for the use of a certain portion of space periodically in the interests of the Society.

Mr. Wigner stated that he had received letters from many gentlemen throughout the kingdom, whose names he read, approving the objects of the Society, and regretting they were not able to attend.

Dr. Tripe proposed the adoption of the report, which was seconded by Mr. G. Turner, of Landport.

Mr. Rimmington said he doubted whether it would be wise for them at present to propose for the adoption o Government any definition of adulteration. He feared whatever they might do would only be subject to criticism, and might very likely be pulled to pieces without producing any useful result.

The Chairman said he thought the discussion on this point had better be raised later, when the proposed definition was brought forward; and the report was then unanimously adopted.

The Chairman then introduced the main business of the meeting, viz., the formation of a constitution for the Society. A printed copy of the one framed by the Committee had been circulated amongst the members, and its adoption he begged leave to move, being pleased to add that no alterations whatever had been suggested in it, though such had been invited.

Mr. Wigner then proceeded to read the suggested constitution and rules, in the course of which Dr. Tripe suggested that the number of honorary members should be limited; and in answer to the same gentleman, the Chairman explained the manner in which the votes would be taken. The objects of the Society were stated to be as follows:—

1. To promote and maintain the efficiency of the laws relating to adulteration.
2. To promote, and as far as possible to secure, the appointment of competent public analysts.
3. To improve the processes for the detection and quantitative estimation of adulterations, and to secure uniformity in the statement of the results by holding periodical meetings for the reading and discussion of original papers on chemical and microscopical analysis, especially with reference to the detection of adulteration.

According to the proposed constitution, the Society will consist of members, honorary members, and associates, the members—in addition to public analysts—being analysts in actual practice, and the associates assistants of analysts, &c. A candidate for admission must be recommended in writing by four members, two of whom must testify to his fitness from personal knowledge. The election is to be conducted by means of voting papers, which may be forwarded by post; three-fourths of the votes, of not less than twelve members, being necessary for election. Members will pay an admission fee of one guinea, and an annual subscription of one guinea; associates will pay an annual subscription of five shillings, and be elected for a period of three years only, at the expiration of which time they may be again recommended for election. The affairs of the Society are to be managed by a Council, consisting of the President, two Vice-Presidents, Treasurer, two Honorary Secretaries, and not more than six other members.

A brief discussion arose as to whether membership was open to all analytical chemists, whether public analysts or not, and the Secretary read the resolution passed at the former meeting, showing that this was the intention of the meeting.

The next point on which a difference of opinion arose was on Dr. Tripe's proposal to limit the number of honorary members, and on a vote being taken it was decided by 11 to 3 that the number should not exceed twelve. With one or two verbal alterations, and the addition of a provision for summoning extraordinary general meetings on a requisition signed by eight members, the rules as printed were adopted on the motion of the Chairman, seconded by Mr. Wanklyn.

Mr. Cleaver and Mr. Piesse were appointed scrutineers to examine the balloting papers for the Council and officers of the Society, and whilst they were so engaged—

Dr. **TRIPE** moved a vote of thanks to the Committee for their past labours, which was seconded by Dr. **MUTER**, carried unanimously, and briefly acknowledged by the Chairman.

Mr. A. H. **ALLEN** drew attention to a compilation and classification of the evidence taken before the Adulteration Act Committee of the House of Commons during the last session, circulated semi-privately, he believed, by some gentlemen connected with the Grocers' Association, and read several questions and answers from the compilation referred to, which differed entirely from the authorised report as appearing in the Blue Book.

Mr. **ESTCOURT** (Manchester) also spoke of having noticed similar errors, some of which seemed to arise from something worse than carelessness.

The result of the scrutiny showed that the Council and officers proposed by the Committee had been elected by a large majority, the names being as follows:—

President, Prof. Theophilus Redwood, Ph.D.; Vice-Presidents, A. H. Hassall, M.D., and J. A. Wanklyn, M.R.C.S.; Honorary Secretaries, C. Heisch and G. W. Wigner; Treasurer, T. Stevenson, M.D.; other Members of Council, Messrs. Allen, A. J. Bernays, C. Estcourt, G. A. Rogers, M.R.C.S., F. Sutton, J. W. Tripe, M.D.

Mr. F. **SUTTON** (Norwich) moved that the annual meeting of the Society should be held on the first Tuesday in the month of February each year, that the ordinary meetings should be held on the first Tuesday in the months of March, May, and November, and that a provincial meeting should take place in August or September.

Mr. **RIMMINGTON** seconded the motion.

Mr. **ALLEN** suggested that the first week in the several months named be chosen, but that the day be left open. After some conversation this was agreed to, and the resolution was passed unanimously.

A resolution having been passed for the immediate payment of a subscription in order to defray the necessary preliminary expenses, the meeting adjourned for refreshments.

A few interesting novelties in analytical appliances were shown in the refreshment room.

On resuming business, the **CHAIRMAN** said the next question for discussion was the definition of adulteration—a very important subject, which would be introduced by Mr. Heisch.

Mr. **HEISCH** said the definition proposed had been already circulated amongst the members, and he hoped had been carefully considered: to show how far it was intended to be definitely adopted, he would read the resolution, which he should conclude by moving, viz.,

> "That the following having been unanimously agreed to by the Committee appointed for the purpose, is considered by this meeting as a fair definition of an adulterated article, and they recommend it to the Council of the Society as one which may advantageously be *adopted as a guide*." The definition was as follows:—

PROPOSED DEFINITION.

An article shall be deemed to be adulterated:—

A. In the case of food or drink—

1. If it contain any ingredient which may render such article injurious to the health of a consumer.
2. If it contain any substance that sensibly increases its weight, bulk, or strength, unless the presence of such substance be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or be acknowledged at the time of sale.
3. If any important constituent has been wholly or in part abstracted, without acknowledgment being made at the time of sale.
4. If it be a colourable imitation of, or be sold under the name of, another article.

B. In the case of drugs—

1. If when retailed for medicinal purposes, under a name recognised in the British Pharmacopœia, it be not equal in strength and purity to the standard laid down in that work.
2. If when sold under a name not recognised in the British Pharmacopœia, it differ materially from the professed standard. Proposed standards and limits for milk, skim-milk, butter, tea, cocoa, and vinegar, were then given.

In the first place, it would be observed that the Committee had not quite followed the instructions given them, to draw up a definition of adulteration, but, acting under what they believed sound legal advice, they had endeavoured to lay down what should constitute an adulterated article, leaving it open for other things to be considered adulterated or not, in the discretion of analysts and magistrates. Instead, therefore, of attempting to define adulteration in the abstract, they had said such and such things should be deemed to constitute an article adulterated, though not saying that nothing was to be considered unadulterated which did not come under those conditions. The Committee had had before it a definition much more sweeping than that now adopted, and he had at first been inclined to support it; but on consideration it was found that a schedule of exceptions to it would have been required, and it was ultimately rejected on that ground, though even the present one was not quite free from the same objection. It was, in his view, very important to bear in mind the distinction between defining adulteration and saying that certain things should be considered adulterated; because the latter left more discretion to analysts, and also to magistrates, who would, in many instances, be the final judges whether an article was adulterated or not. It had been found desirable to distinguish between drugs and articles of food or drink, and also to avoid the use of the word "add" in any shape. The Act was intended not only to protect the public health, but also to prevent imposition, and whether the adulteration arose from wilful fraud, or from ignorance or carelessness on the part of the dealer, he believed the public were equally entitled to protection. The question of fraudulent intent would no doubt be considered by the magistrate in imposing the penalty; but such matters did not come properly within the scope of the analysts' functions, and they had therefore omitted any such words as either "add" or "fraudulently," simply defining an article to be adulterated if it contain such and such ingredients, or did not contain a sufficient proportion of certain others. Having read the definition as above given, he suggested that Clause A 4 might be added to B, and concluded by moving the resolution.

Dr. Dupré having seconded it, *pro forma*,—

Mr. Wigner read the various suggestions which had been received, the most important of which were—the addition of the word "foreign" in Clauses 1 and 2, and the substitution of "fraudulent" for "colourable" in Clause 4.

Dr. Dupré said these definitions, although not put forward as final, had not been adopted without very mature consideration, and after repeated discussion of a great many suggestions, most, if not all, of which had been either adopted or distinctly rejected after examination. Indeed, many suggestions which at first sight seemed very reasonable, appeared on further consideration totally inadmissible. Thus the Committee had unanimously come to the conclusion that this was so with regard to the insertion of any such word as "fraudulently" or "wilfully," because it was hardly ever possible to prove a fraudulent intention, and the introduction of such words would practically render the Act a dead letter. Such points might very properly be considered by the magistrates, but had no place in a definition of adulteration, as applied to the article. Their object had been to make the definition sufficiently comprehensive to ensure the conviction of any one who so far tampered with any article as to make it injurious either to the health or pocket of the customer; but they had not found it practicable so to frame it as to include certain fancy articles, as they might be termed, which contained only an infinitely small amount of certain ingredients, and, if it had been practicable, he did not know that it would have been desirable. On the other hand, they desired to make their definition so elastic that it should not interfere unnecessarily or unfairly with the manufacturer or vendor. The proposal to add the word "foreign" to the first clause had been made in several quarters, but it had been distinctly rejected by the Committee, because its insertion would practically render it almost impossible to secure a conviction, there being such a vast number of ingredients present, in very minute quantities, that it would often be difficult to convince a magistrate that the adulterant was really foreign to the substance, and that it had been improperly added. Objections had been taken to Clause 1 that a teetotal analyst might be induced under it to certify that wine or beer was adulterated because it contained alcohol, which *he* deemed injurious to health; but this danger he thought entirely visionary. The insertion of the word "foreign" in Clause 2 would be even more objectionable than in Clause 1, and it might lead to great difficulty in the case of adulteration of milk with water; he suggested, however, that it would be improved by adding after the words "weight, bulk, or strength," the words "*or materially alters its apparent quality*." The addition of alum to bread, or of Cayenne pepper to gin, could not be considered injurious to health, unless in considerable quantities, nor did it add to the weight or bulk, but it gave a deceptive appearance of flavour. The word "colourable" in Clause 4 he thought might with advantage be omitted altogether. He was sure the Council would welcome any further suggestions, and he would urge the meeting not to come to any absolute decision upon the matter, but simply refer the matter back to the Council for final revision.

Mr. Sutton asked if it was intended to hand in this definition to the Chairman of the Local Government Board, the advisability of which he much doubted.

Mr. Wigner said that was the ultimate intention, no doubt, but not at the present stage.

Mr. Sutton said there appeared to be a great difficulty in fixing upon a definition which would meet the views of everybody, even amongst themselves, and still less the views of magistrates who had to administer the law; therefore, until they were asked for it, he did not think they should volunteer one to the Government. He had no doubt that any fresh bill which might be prepared would be so framed as to cover all things which it was considered desirable to prohibit, and then probably the analysts would be asked for information on matters coming within their own province. His own opinion was that some of their brethren had been much too particular, had drawn the line too stringently, and had not sufficiently considered the difficulties with which traders had to contend. If this sort of thing were pushed too far it would produce a spirit of antagonism which would result in no good to anybody. His experience was that the public really cared very little what they ate or drank, for there was hardly a case to be found in which the prosecution had not been initiated by the officers appointed under the Act.

Mr. Rimmington agreed with Mr. Sutton, and thought they would make a great mistake in drawing up a definition which should either be handed to the Government or made public in any way.

Mr. Piesse begged to differ *in toto* from the last two speakers. In his opinion both the public and the analysts would benefit greatly by a definition being drawn up on a subject upon which the greatest ignorance generally prevailed.

Dr. Stevenson thought they would follow the wisest course in leaving this matter to the ultimate decision of the Council, though he saw no possible objection to the publication of the definition as at present framed. If they were as a body to ask for any alteration in the existing law, there could be no doubt they would be asked to state what their idea of adulteration was, and though they might not have framed their definition in strictly legal language, they ought to be in a position to state in plain English what their view of the question was. This definition was the product of a vast amount of labour and inquiry in all quarters, and he thought they could not do better than refer it back to the Council with their general approval.

Dr. Tripe thought their course was quite clear. In the infancy of the Society they should not go before the public saying this or that is our definition of adulteration, but they should lay down something for their own guidance, so as to secure unanimity amongst themselves. The proper course, therefore, was to refer the matter back to the Council, as had been proposed.

Mr. Wanklyn said they must face the question before them. To refer back these definitions to the Council was to provisionally adopt them, and he certainly could not see that they would be going too far in so doing. With regard to the clauses under section A, they had simply adhered to the Act as it stood, and was being interpreted by the magistrates. A man was to be punished if he poisoned any article of food or drink, or if he diminished its value and cheated his customer, and these ideas were here carried out. He quite agreed in the remarks which had been made as to the impropriety of introducing the word "foreign," which would often prevent a conviction where it ought to be obtained, and also approved of the omission of the word "colourable."

Mr. Allen remarked that few gentlemen present probably were aware of the immense amount of labour which had been bestowed upon the framing of this definition. The Committee had obtained some twenty definitions from the leading chemists of the kingdom, and then having procured a list of the most frequent adulterations, had compared them, *seriatim*, with the definitions, to see which most fully met the case; they had then been revised by independent persons, and legal opinions also had been obtained. He himself had come up to London six times since the end of September on the matter, and others had spent an equal amount of time and trouble upon it. He did not think the Government would be able to deal with the question in so thorough a manner. He still thought the phraseology capable of improvement, though he had been pretty well convinced, contrary to his previous impression, that the insertion of the word "foreign" would be a mistake.

Mr. Rimmington having read a definition which he had drawn up, containing the words, "the same being done covertly to defraud and deceive the purchaser,"

Mr. Heisch said that would be making the analyst judge and jury. They had decidedly come to the conclusion not to meddle with the question of intention.

Mr. Rimmington thought it was necessary to show the intention in order to prove adulteration.

Dr. Tripe said unfortunately his first two cases broke down on that very ground, but on fresh summonses being granted under section 2, instead of section 3, convictions were obtained.

Mr. Wigner said he would read the opinion of a legal gentleman on this very point. He said, "How is it to be determined that water in butter has been *fraudulently* added or retained by the retailer?"

Mr. Rimmington said it was to be determined by inference.

Dr. Stevenson said he had had some cases break down on the question of *fraud*, and practically it was found useless to take out a summons under that section. The personal imputation was so great that hardly any local Board would prosecute, and magistrates would admit every possible excuse rather than convict; whereas, if it was simply a question of adulteration, a conviction was readily obtained, and very rightly in many cases. The old Act of 1860 was an illustration of this, for it remained a dead letter.

Mr. Wanklyn remarked that it was evident their duties were much simplified by the tacit admission of the magistrates, that persons who sold goods were bound to understand what they were dealing in. They had simply to testify as to the quality of the article, and, if it was not what it should be, the trader must suffer the consequences of his ignorance or carelessness.

Dr. Muter said it was evident to all who knew anything about the working of the Act, that it would break down if fraudulent intent had to be proved. He was concerned in the first case ever brought under the Act, which was withdrawn on that ground under the advice of Mr. Poland. He thought the definition a very good one.

Mr. Sutton wished it to be understood that he cordially approved of the definition for their own use, though he doubted the wisdom of too hastily publishing it or laying it before the Government.

The Chairman said he should like to make one or two remarks before putting the motion. In the first place, he thought it was very desirable, as had been so well explained to the meeting, that they should arrive as near as possible to a clear conception of what they thought would be a fair definition of an adulterated article. Having taken part in the discussions on this subject, and the more it was discussed the better, instead of becoming more confident in their ability to make, in every respect, a good, comprehensive, and explicit definition, he became more and more doubtful as to its possibility. In several respects his opinion had materially changed since he commenced looking at the question, and he regretted that even at the present time he was unable to entirely agree with the definition now put forward. He believed he had been the principal dissentient in the Committee, having entertained serious doubts from the first as to whether they had framed such a definition as it would be desirable to lay before the public. However, the resolution as proposed had avoided this difficulty, because they did not propose that the Society should be strictly tied down to the definition now brought forward; but all agreed in this, that it was desirable they should indicate as far as possible, in intelligible terms, what were the conditions under which articles should be looked upon as adulterated. He was not quite satisfied, and did not think he ever should be, with this amount of success, because if they were to have a definition, he, for one, desired one which should cover all articles which could be considered as adulterated, and if they fell short of this, and found they could not frame a definition which would be so comprehensive as to take in everything, but at the same time elastic enough for purposes of commerce and manufacture, he should be inclined to come to the conclusion that they had better not have one at all, but simply depend upon the Act itself, which specified in so many words that if an article were adulterated in whatever way, not defining what that way should be, the seller was subject to a penalty. It was quite possible they might come to that conclusion at last, but he had originally entertained a strong opinion that without much difficulty they might frame a definition which would be both stringent enough on the one hand, and elastic enough on the other, to cover all cases which they required to take cognisance of. At the same time he must confess that the more he looked into the subject the more difficulties he saw. He thought, however, they would show a great amount of weakness if, as a body, they drew back from the attempt to do all that could be done towards defining what constituted an adulterated article. He hoped they would endeavour to do this, but their first object must be to do it for their own use, so that they might be able to agree amongst themselves, and further be in a position to enlighten the public upon the matter; but they must not decide too hastily what use to make of the definition when accomplished. The one now proposed was framed in popular rather than in strictly legal or technical language, but it gave a very good general idea of what was intended, and if the Society agreed to the resolution which had been proposed, that it should be sent back to the Council for further consideration, he thought that would be the best course that could be adopted.

The motion was then put and carried unanimously.

Section B, the discussion of which had been postponed until after Section A had been disposed of, was next brought forward, when

Dr. Tripe proposed that in clause 2 the words "or its synonym" should be added.

Mr. Rimmington said he doubted very much, with regard to many popular medicinal agents, whether it was not better for the purpose the more they were adulterated. Take, for instance, such articles as laudanum or sweet spirit of nitre. He believed, if they were sold of the pharmaceutical strength, there would very soon be a great many inquests required. In his part of the country persons were in the habit of taking sweet spirit of nitre by the ounce or half-ounce, and they would have great difficulty in convincing ignorant persons that they only ought to take a teaspoonful. The same thing with regard to spirit; he thought the more water there was in it the better.

Dr. Tripe could not understand what the "professed standard" meant.

The Chairman said the name of the article, or the label affixed to it, might imply a standard. With regard to articles of medicine, not comprised in the "Pharmacopœia," there was a generally recognised composition which would be the professed standard.

Mr. Wigner said if an article had no synonym it would be shut out altogether; and this was the case with many articles, such, for instance, as milk of sulphur.

Dr. Tripe said milk of sulphur was the synonym for precipitated sulphur, according to Garrod.

Dr. Stevenson said the professed standard did not mean that of the Pharmacopœia, but it meant that when the article referred to was something which had either an acknowledged standard as being a natural product, or was generally known as of a certain composition, it should come up to that standard. It would introduce a great amount of confusion in the definition if they adopted the word "synonym," because there were many articles which, though approximating to the preparations in the British Pharmacopœia, had no synonyms, strictly speaking. Milk of sulphur for instance, was a recognised substance known to chemists as distinct from the substance known as precipitated sulphur, having long been prepared in a different manner. Paregoric, again, was not the same as compound tincture of camphor, which latter was really an imitation of paregoric. Of course if any article were the true synonym of one in the Pharmacopœia, the Pharmacopæia standard would be applied to it.

Dr. Tripe said he would withdraw his suggestion.

Mr. Piesse suggested the substitution of the word "its" for "the" before "professed standard," and a similar resolution to the last was then unanimously adopted with regard to section B. A somewhat lengthy discussion then ensued as to the latter part of the definition, and the proposed standards, which stated—

Various suggestions were made by members as to some of the details therein contained, and facts narrated as to the working of the Adulteration Act, particularly with regard to the sale of milk; ultimately a similar resolution recommending these standards to the Council for their guidance was adopted, but with the understanding that the word "limits" should be substituted for standards." A vote of thanks to the chairman concluded the proceedings, which had lasted over four hours.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 3rd, 1874.

Mr. W. H. Perkin, F.R.S., in the Chair.

The minutes of the previous meeting having been read and confirmed, and the names of the visitors announced, the certificates of Messrs. J. Martineau Poynting, George Turner, and Nathaniel Bradley were read for the first time. The following gentlemen were duly elected by ballot as Fellows of the Society, after their names had been read for the third time:—Messrs. Thomas Harrison, A. L. Sparkes, B.A., D. Kingsford, Edward William Parnell, Robert Hedderwich Ker, Arthur Deck, John Edward Morris, Roland H. Ridout, William Payne, William Griffin, and D. C. Mackenzie.

The first paper, "*On the Formulæ of the Alums,*" was read by the author, Mr. S. Lupton. He finds that ammonia-iron alum, $(NH_4)_2Fe_2 4SO_4,24OH_2$, loses $23OH_2$ at a temperature of 150° C., and becomes anhydrous at about 230° C. The alums $K_2Al_2 4SO_4.24OH_2$ and $(NH_4)_2Al_2 4SO_4,24OH_2$ both lose 23 molecules of water at temperatures of 180° C. and 190° C., respectively. These results prove that the formulæ of the alums given above cannot be halved, unless the improbable assumption be made that 2 molecules of alum coalesce in the formation of the mono-hydrated salts described by the author.

The Chairman having thanked the author,

Mr. W. N. Hartley read a note "*On the Colour of Cupric Chloride.*" He finds that the crystals of cupric chloride, $CuCl_2.2OH_2$, which are generally described as green, are really of a pale blue tint when rendered quite free from adhering moisture by exposure *in vacuo* over sulphuric acid. The green colour of the crystals, as ordinarily seen, he considers to be due to their being moistened with a film of the deep green solution of the salt. When examined by the dichroiscope, the light through the principal axis shows one image of an azure blue, and the other of an emerald green.

In reply to a question by Mr. C. E. Groves, the author said he had not examined the light from the dark blue crystals and the moist green crystals by the spectroscope; there were considerable difficulties, owing to the small size of the crystals and their giving a continuous spectrum.

The Chairman then thanked the author in the name of the Society, after which

Mr. C. T. Kingzett read Part II. of a communication "*On the Oxidation of the Essential Oils.*" The results of his more recent experiments induce the author to believe that the active agent produced by the atmospheric oxidation of oil of turpentine, which was described in the first part of the memoir, is probably an organic peroxide of the formula $C_{10}H_{14}O_4$, and that, on heating this product with water, peroxide of hydrogen and camphoric acid are formed, and remain in solution in the water.

$$C_{10}H_{14}O_4 + 2OH_2 = C_{10}H_{16}O_4 + H_2O_2.$$

Acetic acid and formic acid appear to be formed at the same time.

The Chairman then thanked Mr. C. T. Kingzett in the name of the Society for his interesting communication on the nature of the products formed in the oxidation of oil of turpentine.

The two remaining papers were "*On the Purification and Boiling-Point of Methyl-Hexyl-Carbinol,*" by E. Neison; and a "*Note on the Boiling-Point of Methyl-Hexyl-Carbinol,*" by C. Schorlemmer, F.R.S. The former finds that it is impossible to obtain the alcohol entirely free from the ketone which accompanies it, by means of treatment with acid sodium-sulphite, neither is the impurity removed by rectification with potassium hydrate; it then boils at 178° to 179° C. By digesting it, however, with potassium hydrate for a considerable time, the last trace of the ketone may be removed. After being carefully dried and rectified, it boils steadily at 181° C. Under some circumstances, the crude alcohol contains a small quantity of octylene and traces of octane. The former may be removed by the action of bromine, which converts it into octylene-bromide, a liquid of high boiling-point. The pure alcohol is an almost colourless, very mobile liquid, the density of which is 0·823 at 16°. Oxidising agents convert it into methyl-hexyl-ketone, and ultimately into caproic and acetic acids; heated with zinc chloride in a current of hydrochloric acid, it is rapidly converted into octylic chloride, a small quantity of octylene being produced at the same time.

Dr. Schorlemmer, by repeatedly distilling the alcohol, first from potassium hydrate and then from metallic sodium, obtained a liquid boiling constantly at 179·5°, the mercurial column being completely surrounded by the vapour, and the height of the barometer 756 m.m. The author finds that pure primary heptyl-alcohol boils at 155·5° C.

The Chairman, after thanking Mr. Neison and Dr. Schorlemmer, adjourned the meeting until Thursday, December 17th, for which there are communications from Dr. Schorlemmer, "On Groves's Method of Preparing Chlorides," and from Mr. J. L. Davies, "On the Precipitation of Metals by Zinc."

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, December 7th, 1874.

Admiral Sir Henry J. Codrington, K.C.B., Vice-President, in the Chair.

The Hon. Mrs. Francis Wm. Buxton, William Henry Domville, Esq., and George Sampson, Esq., were elected Members of the Royal Institution.

The following Lecture arrangements were announced:—

John Hall Gladstone, Esq., Ph.D., F.R.S., Fullerian Professor of Chemistry, R.I.—Six Lectures, "On the Voltaic Battery," on December 29 (Tuesday), 31, 1874; January 2, 5, 7, 9, 1875.

Before Easter, 1875.

E. Ray Lankester, Esq., M.A.—Six Lectures, "On the Pedigree of the Animal Kingdom," on Tuesdays, January 12 to February 16.

Alfred H. Garrod, Esq.—Four Lectures, "On Animal Locomotion; including Locomotion on Land, in the Air, and in Water," on Tuesdays, February 23, March 2, 9, 16.

Professor P. M. Duncan, F.R.S.—Three Lectures, "On the Grander Phenomena of Physical Geography," on Thursdays, January 14 to 28.

Professor Tyndall, D.C.L., LL.D., F.R.S.—Seven Lectures, "On Subjects connected with Electricity," on Thursdays, February 4 to March 18.

Edward Dannreuther, Esq.—Two Lectures, "On Mozart and Beethoven (with Pianoforte Illustrations)," on Saturdays, January 16 and 23.

J. T. Wood, Esq.—Four Lectures, "On the Discovery of the Temple of Diana, and other Results of the Government Excavations at Ephesus," on Saturdays, January 30, February 6, 13, and 20.

Professor W. K. Clifford, M.A., F.R.S.—Four Lectures, "On the General Features of the History of Science," on Saturdays, February 27 to March 28.

The Friday Evening Discourses before Easter will probably be given by the following gentlemen:—

January 15th, Professor Tyndall, D.C.L., LL.D., F.R.S., "Some Acoustical Problems." January 22nd, Sir John Lubbock, Bart., F.R.S., M.R.I., "Wild Flowers and Insects." January 29th, Professor Huxley, LL.D., F.R.S., "Recent Work of the *Challenger* Expedition, and its Bearing on Geological Problems." February 5th, James Dewar, Esq., F.R.S.E., "Physiological Action of Light." February 12th, W. R. Greg, Esq. February 19th, Professor Frankland, F.R.S., M.R.I., "Climate." February 26th, W. R. S. Ralston, Esq., M.A., "Popular Tales: their Origin and Meaning." March 5th, The Lord Rayleigh, M.A., F.R.S., M.R.I. March 12th, Professor Abel, F.R.S., "Accidental Explosions." March 19th, Richard Liebreich, M.D., M.R.C.S., M.R.I., "The Real and Ideal in Portraiture."

CORRESPONDENCE.

THE NEW SCIENCE SCHOLARSHIPS AT OXFORD.

To the Editor of the Chemical News.

Sir,—Much high-toned discussion recently took place when our great universities first established scholarships for the promotion of scientific study, and it it is now quite permissible to ask what these scholarships really are, and in what manner they are administered.

A specimen has recently come under my notice which, if at all typical of the remainder, is perfectly horrifying. This is the first, and presumably the simplest, chemistry paper, given for an *entrance* scholarship at Oxford:—

Chemistry. I.

1. Discuss the methods and aims of Physics in contrast with those of Chemistry, and show the directions in which the one branch of study assists the other.
2. Give a history of the atom since the year 1800.
3. What reasons are there for belief in the duality of elementary molecules?
4. "The theory of polyatomic radicles and the theory of types are necessary to each other." Examine this statement.
5. The specific heat of a certain metal is 0·057: the metal forms an oxide containing by weight 1 part of oxygen to 4·725 of metal, and a chloride containing 1 part of chlorine to 1·064 of metal. Wht formulæ probably represent these compounds?

(*Balliol College, Brackenbury Scholarship*, 1874.)

The other two papers, as well as the practical part of the examination, clearly exhibit either non-acquaintance with the routine of laboratory work on the part of the examiner, or a desire to ignore the same. The papers are too lengthy to give here, still, I cannot refrain from quoting one of the questions on organic chemistry:—"What are the chemical characters of soap, sugar, starch, gun-cotton, nitro-glycerine, tallow, and paraffin?"

Is this, alas! the chemistry expected from young students about to undergo a course of university study? Is a *mere memory* of undigested facts to take the place of real knowledge obtained from the facts themselves? for such is the real issue. Can any youth possess at the same time such unlimited book-knowledge, and yet be at all adept in chemical methods?

And, in conclusion, allow me to ask what kind of "chemist" will emerge from the university if they be already so "super-saturated" with book-knowledge when they enter?—I am, &c.

Experiment.

WANT OF COURTESY.

To the Editor of the Chemical News.

Sir,—I wish, through the medium of your paper, to point out an act of great injustice perpetrated by those who advertise for Managers, Chemists, Foremen. &c.

In a great majority of cases, and I speak on the authority of several persons who fill the positions above-named, the firm advertising open out a correspondence with some of the applicants, and it may be that several letters pass between them, and, after all, nothing more is heard from the advertisers; they cease to write, and the applicants are consequently kept in an unenviable state of suspense. Now, sir, would it not be better and more gentlemanly on the part of the advertisers to inform the applicants that their vacancies have been filled, and that their services are not required? So long as advertisers continue to treat applicants so unceremoniously, they will never get really competent men to countenance them,—I am, &c.

A Constant Reader.

North Shields, December 2, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 18, November 2, 1874.

Researches on the Dissociation of Crystalline Salts.—MM. P. A. Favre and C. A. Valson.—A complete abstract of this paper cannot be given without the accompanying tables. When a hydrated salt dissolves the increase of the volume of the liquid differs, in general, little from the volume of the salt. The three or four first equivalents may give rise to a slight coercitive action, but this ceases, and the increase of the volume becomes constant. In this respect the solution of a hydrated saline crystal may be compared to the melting of a crystal of ice in water, which is accompanied by a slight contraction.

Modification of the Liquids of Fehling and Barreswill, as Employed for the Determination of Glucose.—M. P. Lagrange.—The author proposes the following formula:—

Dry neutral tartrate of copper ..	10 grs.
Pure caustic soda	400 ,,
Distilled water..	500 ,,

The tartrate of copper is obtained by decomposing the sulphate of copper with neutral tartrate of soda, the precipitate being washed by decantation, and dried at 100° C.

Fermentation of Fruits.—MM. G. Lechartier and F. Bellamy.—The authors have submitted cherries, gooseberries, figs, lemons, cherry and gooseberry leaves, chestnuts, and barley to experiments similar to those already performed with apples and pears. The results were identical. They draw the following conclusions:—At the moment when the fruit, the grain, or the leaf is severed from the plant life is not extinct in its component cells. This life is accomplished, in the exclusion of air, in consuming sugar, and in producing alcohol and carbonic acid. As soon as the production of the latter ceases all vitality is extinct in their cells. Fruits, seeds, and leaves may therefere remain indefinitely in an inert state if no organic ferment is developed in their interior. Beet-roots and potatoes present a special phenomenon. As regards the production of alcohol and of carbonic acid they behave like fruits. They do not contain any alcoholic ferment, but in the acid liquid which saturates the mass of their softened tissues, the authors have recognised bacteria of different sizes.

No. 19, November 9, 1874.

Researches on the Dissociation of Crystalline Salts.—MM. P. A. Favre and C. A. Valson.—The coercitive action which a crystalline salt exerts on its water of crystallisation is not of the same order as the coercitive action exerted by the same salt, when dissolved, upon the mass of the solvent. In the former case the salt, in isolating itself from the medium, retains a definite number of equivalents of water, and its action consequently follows the law of definite proportions. In the second case the action is exerted upon the entire mass of the solvent, and consequently in indefinite proportions. When a dissolved salt crystallises in a saturated solution the phenomenon is generally accompanied with augmentation of volume, and at the same time with disengagement of heat. The influence of temperature upon the number of equivalents of water retained by the crystal must be noticed. Thus sulphate of soda, at common temperatures, takes up 10 equivalents of water: at a sufficiently elevated temperature the number of equivalents decreases; and above 33° a saturated solution deposits the salt in the anhydrous state. It would, therefore, seem that the action of heat upon saline solutions may be compared to that which it exerts upon the systems formed by carbon and the gases which it condenses. If we admit that the coercitive action of salts upon water decreases with the temperature we may explain the increase of solubility with temperature for the majority of salts. Indeed, if we set out with a solution saturated at the ordinary temperature, and raise the temperature, the coercitive power of the salt diminishing, it necessarily follows that one portion of the mass of the water escapes entirely, or almost entirely, from the coercitive action of the salt, and is thus ready to undergo the coercitive action of a new portion of the salt, which then enters into solution. We may add that in raising the temperature more and more, the coercitive action becoming more and more feeble, we reach a limit beyond which a portion of the salt is deposited. This explains the maximum of solubility for certain salts. We conceive, finally, that at still higher temperatures the coercitive action may become $=0$, and the salt be then entirely deposited in the anhydrous state. With the greater part of salts which fix water of crystallisation the solution of these hydrated salts takes place without any sensible variation of the entire volume, when the liquid is sufficiently concentrated, which is generally the case with the third or fourth equivalent of the salt added. With anhydrous salts this is no longer the case. Hence it follows that the number of equivalents of water which a salt retains at the moment when it crystallises depends on this condition—that the solution of the salt is effected without change of volume. Lastly, let us consider the coercitive action, A, which an anhydrous salt exerts upon the indefinite mass of the solvent water compared to the coercitive action, B, exerted by the salt upon the definite proportion of water necessary for the constitution of the crystal. If these two actions are equal the hydrated and crystalline salt dissolves without alteration of volume. If A is greater than B there will be increase of volume in crystallisation, and decrease in case of solution. If B is greater than A the case will be reversed.

Method Adopted for the Discovery of the Substance Most Effectual Against the Phylloxera at the Viticultural Station of Cognac.—M. Max Cornu.

Certain Geometric Constructions Applicable to Mirrors and Lenses.—M. J. Lissajous.—A mathematical paper, unsuited for abstraction.

Preparation and Properties of Dioxy-Maleic Acid.—M. E. Bourgoin.—This acid is formed by heating a dilute solution of bibromo-maleic acid to 160° for six hours in a closed vessel. The acid is soluble in water and alcohol, but scarcely soluble in ether. Its alkaline and alkaline earthy salts are soluble in water. Its existence completes a remarkable series. There are three acids—the succinic, malic, and tartaric, to which correspond respectively the maleic, oxy-maleic, and dioxy-maleic, containing two equivalents less of hydrogen.

Studies Relative to the Phylloxera: Experiments made on Vine Branches Immersed in Water holding Various Substances in Solution.—A. Baudrimont.

Laws of the Vibratory Movement of Diapasons.—M. E. Mercadier.—Not adapted for abstraction.

Electro-Static Induction Currents.—M. Neyreneuf.—Verdet and Masson have made use of the electric egg to determine the direction of the induced current. The author has repeated their experiments, making use of the discharge of a Holtz machine, and has established without difficulty that the direction of the induced current varies with the intensity of the inducing charge.

Action of the Electric Current on the Organs of the Senses.—T. L. Phipson.—It results from experiments made by the author that the action of a galvanic current on the organs of sensation always appears at the positive pole, except at the moment where the negative pole becomes in turn positive, and then an action takes place at this pole. He thinks that in these facts is found the indication of a general law applying equally to the muscular contractions occasioned by electricity, and very probably to the phenomena of induction. If we take a small zinc-copper couple, plunged in acidulated water, and furnished with a platinum rheophore, and place first the zinc pole on one side of the tongue, and then the copper pole on the other side, the well-known and peculiar taste is immediately experienced at the point touched by the copper, but not on the other side. The result is the same if the positions of the poles are changed. If a stronger apparatus is used the phenomena are unaltered, but another fact is also observed—on removing the copper pole the same taste is experienced at the zinc pole. Corresponding phenomena are observed in experimenting on the organs of hearing, smell, and sight.

Reply to a Recent Paper by M. Gernez on Supersaturation.—M. Lecoq de Boisbaudran.—A controversial paper, having reference to *Comptes Rendus*, p. 912.

New Observations Relative to the Circular Compass.—M. E. Duchemin.—The author requests the opening of a sealed paper deposited with the Academy October 27, 1873, in which he describes the construction and the advantages of the circular compass.

Lamp of Sulphide of Carbon and Nitric Oxide, with its Application to Photography.—MM. B. Delachanal and A. Mermet.—If binoxide of nitrogen is kindled in a flask containing the vapour of sulphide of carbon a dazzling light is produced, which immediately causes the mixture of hydrogen and chlorine to detonate. The violet-blue tint of the light proves its richness in the chemical rays. The authors give a description of the lamp, and of experiments made with its light, which proves to be well adapted for photographic purposes. The spectrum of the light is very analogous to that of sulphur.

Chemical Nature of Bodies in the Organism which Exhibit a Cross under the Polariscope.—MM. Dastre and Morat.—In the yolk of the egg of birds are found spherical corpuscles presenting, when examined under the polariscope, a cross whose limbs enlarge as they diverge from the centre. M. Dareste, who discovered these bodies in 1866 in the eggs of birds, has since found them in other animals—tortoises, osseous fishes, &c., and in various parts of the organism. R. Wagner has found them in the *vesiculæ seminales*, and M. Balbiani in the adipose body of the silkworm. M. Dareste considered them as animal starch, and believed that he had transformed them into glucose, making use of this supposed fact as an argument against the localisation of glucogenesis in the liver. The researches of the authors prove that these bodies consist of lecithine, a nitrogenous and phosphorised principle made known by Gobley. It is interesting to find a nitrogenous matter—considered as amorphous, and of a viscid and colloid nature—present a great number of the essential properties of crystals, assuming constantly a regular and symmetrical geometric figure. Lecithine is very distinct from starch; it is not turned blue by iodine; it dissolves in alcohol, and is precipitated by water, whilst the behaviour of starch is quite the reverse. The polarisation-cross being, therefore, not peculiar to starch, its value in proximate organic analysis is not greater than that of an ordinary crystalline form.

Liebig's Annalen der Chemie und Pharmacie.
October 17, 1874.

Behaviour of Iodine with Arsenious Acid.—M. Wegner.—The author undertook the investigation of this subject with reference to a paper by Prof. Zinno (*Buchner's Repertorium*, Heft 7, 1873) on iodarsenic acid. He is unable to confirm the results of Zinno, and doubts the existence of iodarsenic acid.

Ammonia Derivatives of Aceton.—W. Heintz.—A very elaborate account of triacetonamin, triaceton-ammonium-platino-chloride and subchloride, hydrochlorate of triacetonamin, diacetonamin, the two platino-chlorides of diaceton-ammonium, hydrochlorate and sulphate of diacetonamin, and dehydro-triacetonamin.

Certain Formation of Diphenyl within the Molecule.—C. Graebe.—This paper treats of the synthesis of carbazol from diphenylamin; the behaviour of methyl-diphenylamin with heat; of diphenylen-sulphide; diphenylen-sulphon; the behaviour of diphenyl-disulphide with heat; diphenylen-oxide; and diphenylen-methan.

Notice of a Palladium Salt.—The salt in question is a double sulphite of protoxide of palladium and of soda. When dried and washed it is a pale yellow crystalline powder. When heated it becomes yellow, and is then decomposed and blackened. In boiling water it is dissolved and decomposed. It consists of—

Oxide of palladium	20·40
Soda	30·49
Sulphurous acid	42·35
Water	6·76
	100·00

On Diphenyl.—Gustav Schultz.—This valuable paper treats of the preparation and properties of diphenyl; of its mono-substitution products, including brom-diphenyl, $C_{12}H_9Br$; chlordiphenyl (diphenyl-mono-sulphuric acid, oxidiphenyl): nitro-diphenyl, $C_{12}H_9.NO_2$, and meta-nitro-diphenyl; amido-diphenyl, $C_{12}H_9NH_2$; diphenyl-carbonic acid (para-phenyl-benzoic acid), $C_{12}H_9CO_2H$; the di-substitution-products of diphenyl, including dibrom-diphenyl; isobrom-nitro-diphenyl; dinitro-diphenyl, $C_{12}H_8(NO_2)_2$; amido-nitro-diphenyl, its behaviour with oxidising and reducing agents; iso-dinitro-diphenyl, iso-amido-nitro-diphenyl, diamido-diphenyl (benzidin); on the hydrocarbons given off as secondary-products during the preparation of diphenyl, both by Fittig's and Berthelot's method; diphenyl-benzol, $C_{18}H_{14}$; and iso-diphenyl-benzol.

Communications from the Laboratory of the University of Innsbruck.—These communications consist of a paper on the constitution of dioxybenzoic acid, by L. Barth and C. Senhofer; and one by the last mentioned chemist on benzol-trisulphuric acid.

Investigations on the Volume Constitution of Solid Bodies.—Dr. H. Schröder.—The author examines the di- and trichromates of potash; the normal volume of chlorine; the isosterism of the magnesian chlorides and of mercuric chloride; of the anhydrous bromides of the magnesian metals and of mercury; and the normal volume of bromine.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent examinations:—Second B.A. and Second B.Sc. Examinations. Examinations for Honours. *B.A. and B.Sc. conjointly.—Mathematics and Natural Philosophy.*—First Class—M. J. M. Hill, B.A. (Scholarship), University College; J. M. Lightwood,[*] B.A., Trinity Hall, Cambridge. *Logic and Moral Philosophy.*—First Class—J. N. Keynes, B.Sc. (Scholarship), Univ. Coll., Lond., and Pemb., Camb. Second Class—J. Beaston, B.A., private study; R. F. Ferguson, B.A., Univ. Coll.; S. G. Kelly, B.A., New Coll. Third Class—P. K. Ráy, B.Sc., Univ. and Manch. New Colls., and School of Mines; E. P. A. Law, B.A., Univ. Coll.; J. S. Lidgett, B.A., Univ. Coll.; C. E. Moyse, B.A., Univ. Coll.; J. W. Richards, B.A., New Coll.; T. M. Williams, B.A., Univ. Coll. of Wales and private study. *B.Sc. only.—Chemistry.*—First Class—P. P. Bedson (Scholarship), Owens Coll. Second Class—S. A. Hill, Royal School of Mines; B. A. Whitelegge, Univ. Coll. *Geology and Palæontology.*—First Class—S. A. Hill (Scholarship), Royal School of Mines; A. H. S. White, B.A., Univ. Coll. Second Class—P. P. Bedson, Owens Coll.; P. K. Ráy, Univ. and Manch. New Colls., and Royal School of Mines. Third Class—B. A. Whitelegge, Univ. Coll. *Zoology.*—First Class—F. H. Barling, Owens Coll.

NOTES AND QUERIES.

Artificial Tannin.—Many years ago, Hatchete obtained a resinous tannin-like substance by the long-continued action of dilute nitric acid upon charcoal. I shall be much obliged if any of your readers can refer me to any subsequent investigations as to its nature and constitution, or that of the similar substances produced by the action of sulphuric acid on peat, camphor, &c.—Henry R. Procter.

MEETINGS FOR THE WEEK.

Monday, 14th.—Society of Arts, 8. Cantor Lectures. "Alcohol: its Action and its Use," by Dr. B. W. Richardson, F.R.S.
—— Medical, 8.
—— Royal Geographical, 8½.
Tuesday, 15th.—Civil Engineers, 8.
Wednesday, 16th.—Society of Arts, 8. "On the Sandblast, and its Application to Industrial Purposes," by W. E. Newton, Esq.
—— Meteorological, 7.
—— Geological, 8.
Thursday, 17th.—Royal, 8½.
—— Chemical, 8. "On Groves's Method of Preparing Chlorides," by C. Schorlemmer; "On the Precipitation of Metals by Zinc," by J. Davies; "Researches on the Paraffins existing in Pennsylvania Petroleum," by T. Morgan; "Some Remarks on the Preceding Paper," by C. Schorlemmer.
—— Philosophical Club, 6.
—— Zoological, 4.

TO CORRESPONDENTS.

Errata.—Vol xxx., p. 261, 1st column, line 22, *for* "proportion," *read* "proposition;" line 23, *for* "fact," *read* "facts;" line 47, *for* (÷), *read* (:).

Dr. Burghardt, Martin Murphy, and G. C. Stewart.—Next week.

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[*] Obtained the number of marks qualifying for the Scholarship

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THE CHEMICAL NEWS.

Vol. XXX. No. 786.

THE CONFERENCE ON THE SEWAGE QUESTION.

Elsewhere we present our readers with a brief report of the conference on the sewage question, held under the auspices of the Society of Arts. We may congratulate the friends of sanitary reform on the improving prospects of that great national question. The meeting showed a more practical frame of mind, and a greater disposition to look at the matter in a common sense point of view, than has been displayed on any former occasion. There was less of that intolerant disposition which at one time led irrigationists to claim for their process the position of a sewage orthodoxy, outside of which is no salvation. The general feeling of the assembly was well expressed by Dr. Lyon Playfair when he declared that there were several processes known, all capable of giving excellent results, and that the choice in any particular case must depend upon local facilities. Mr. Hope, indeed, declared that, in the opinion of every competent man of science, sewage can only be properly purified by irrigation or filtration through soil. Without any wish to disparage Mr. Hope's military and engineering merits, we cannot accept him as the judge of scientific competence. What is "proper" purification is a matter of opinion. Sewage cannot be rendered absolutely pure and fit for domestic uses by any process practicable on a large scale. We must remember that no sanitary authority would for a moment recommend the drainage of cultivated lands as fit to be admitted into the water supply of a town. If, by proper purification, we mean rendering sewage colourless and transparent, free from all odour, incapable of becoming putrid, or of causing the development of sewage fungus, we must then declare that this can be and has been effected without irrigation.

The question of "standards" underwent a considerable amount of discussion. A member of the late Royal Rivers' Pollution Commission pleaded for some fixed rule to determine whether any particular refuse liquid was admissible into a stream or not, and advocated the adoption of the now celebrated recommendations of that no less celebrated Commission. In defending them against the charge of unnecessary rigour—which, by the way, is not so much their sin as inconsistency—he made the fatal admission that they would not exclude the filthy water of the Irwell! What more is wanting to complete their condemnation. Is not the Irwell notoriously fouler than those effluents from precipitation processes which it was hoped the "Recommendations," if adopted by the Legislature, would exclude? We hope that, when next a copy of the "Recommendations" is sent to any foreign chemist for his approval, it will be accompanied by a Winchester quart of Irwell water by way of illustration.

The majority of the speakers who entered upon this part of the question objected to a hard and fast rule, and preferred an elastic standard, so that every case might be judged upon its own merits, and that the law should be mild at first and be made gradually more stringent as public opinion becomes more enlightened. This is precisely what we have always advocated. We notice with much pleasure the suggestion of Mr. Evans, that the relative proportion of the refuse liquids to the streams should not be overlooked.

Mr. Smee's denunciation of the system of passing sewage over or through growing vegetation was vigorous in the extreme. The charges which he brings can easily be submitted to experimental verification. Meantime, it cannot be denied that several of them have the *a priori* appearance of probability. That vegetables nourished with sewage should putrefy more readily than others is far from unlikely. The same must be said concerning the statement that the milk of cows fed on sewage-grass was abnormally ready to enter into decomposition. Nor can we wonder if the roots of sewage-grass are coated with excrementitious matter which readily betrays its origin. We must point out that the Prussian commissioner, Lefeldt, found the grass from an irrigation field near Edinburgh saturated, for some inches, with "unassimilated fæcal matters." Mr. Smee thinks that irrigation, where adopted, should be preceded by some precipitation process. The attempt of Mr. Bailey Denton to refute Mr. Smee was eminently unsuccessful. The former gentleman (if we did not misunderstand him) contended that sewage matters would not cling to the roots and stems of grass, &c., if the soil were sufficiently porous—a plea which cannot be entertained for a moment. Nor is it much more logical to contend that, because a bull has been fed on sewage-grass, and, when slaughtered, shows no mark of disease, entozoic or otherwise, that therefore irrigation with untreated sewage is safe. Disease, in man or beast, is the result of a complication of causes. So long as one of these is wanting, the effect does not ensue. We could point to villages in Suffolk where the inhabitants obtain their water from road-side ponds contaminated with the drainage of manured fields and the oozings from farm-yards and cess-pools. The standard of health in such districts is fair; but let once the germs of any zymotic disease be introduced, and then, as the late Dr. Lankester remarked in a lecture at Stowmarket, the living will scarcely suffice to bury the dead.

It was satisfactory to observe that sewage was decidedly regarded by the meeting, not as a source of wealth to be held back while the market rises, but simply as a nuisance which must be abated, profitably if possible, but at all events abated. It is all very well to calculate the expense of treatment, and avoid any needless increase of municipal burdens; but, as one of the speakers pointedly observed, local authorities should also count the cost of neglect. We are by no means certain that the latter will prove the lighter. Persistence in polluting streams, until some self-sacrificing company offers a royalty for the honour of purifying their sewage, is a delusion which municipal authorities will do well to throw aside.

The tone taken by the conference will undoubtedly strengthen the hands of Government in compelling towns to adopt some remedial measures. But the attempt to dictate any one particular process, or to adopt the standards of the Royal Rivers' Pollution Commissioners, will meet with the most determined opposition.

EXPERIMENTAL RESEARCHES ON VEGETATION.

THE EMPLOYMENT OF VEGETATION TO ASCERTAIN AND DEFINE THE MOLECULAR STATE OF BODIES;

THE ANALYSIS OF VEGETABLE EARTH BY RATIONAL METHODS OF CULTURE.

By M. GEORGES VILLE.

SOME years ago, I called the attention of scientific men to some facts in vegetation of a new order, of which I was not able at the time to define the character with any amount of certainty, nor foresee all the results. More fortunate at this time, I believe I am able, in a measure, to assign to my experiments their true signification. We can employ vegetation to aid us in penetrating the molecular state of bodies, and analysing the vegetable earth by rational methods of cultivation. These are the two conclusions to which all my work has led me.

The thoughts that vegetation awakens in us are so removed from molecular and analytical chemistry that, in spite of myself, I feel a sort of diffidence in tabulating these conclusions. Convinced, however, of their accuracy, and desirous of answering the doubts which may arise from them, I will give the history of my observations in the order in which they were made. I will not deny that chance and intuition have had much to do with these discoveries; and I will not, therefore, have recourse to the artifice of a methodical statement drawn up after the research is finished, to enhance its merit and originality.

In researches founded on experiment, it frequently happens that facts cause us to give up our preconceived ideas, even to make us abandon the track that we were following. But it also happens that a happy accident opens to us a new field for work. After this period of doubt and uncertainty, where the unforeseen occupies the first place, there comes a time when we feel the ground firm under our feet, and a dominant idea inspires and directs us. From this time the experiments co-ordinate, and their results harmonise and point towards one common end.

Experiment then commences to be an instrument of discovery in our hands, conducting us, by a succession of doubts more and more diverse, to a new order of ideas, or, to make use of a hackneyed formula, causing us to pass from the known to that which yet remains unknown. Later, its *rôle* becomes more humble, and its office more subordinate. It is then when, determined on the general sense of phenomena, we ask experiment to produce its first proofs, in order to definitely complete the certainty and the degree of generality.

The explanation which follows will participate in these two characteristics; at first, indefinite and halting; later on, more concordant, more confidant, and affirmative. This change will mark the term of uncertainty inseparable from the novelty of the results, and will testify to the effort by which the mind enters at last into the possession of ideas true in themselves and carrying their own conviction.

A great master of the art of interrogating nature has written, in a celebrated preface, these remarkable lines:—"There are men who, to acquire a little more reputation, keep back a new fact that, perhaps, they have not had much merit in discovering, until they can astonish the world by a system as complete as it is new, and give a prodigious idea of their judgment and penetration. But they are justly punished for their ingratitude towards the source of all knowledge, and they fail in true love to science and to humanity, in finding the discovery of which they are so proud divulged by men whose natural ardour leads them to physical research, and who communicate freely to others all that is presented to them in their work. For myself, I find it absolutely impossible to produce a work on the subject of which I am treating which leaves nothing to desire."[*]

The authority of Priestley that I have just quoted is introduced at this time for my excuse and justification if the results that I now publish are found in any way incomplete or defective.

I.—Everyone knows now that phosphorus is one of the most essential agents of vegetable life. It is further known that it is by means of earthy or alkaline phosphates that it fulfils its most important functions. But phosphorus forms with oxygen, independently of phosphoric acid, two other acids less oxygenated, phosphorous acid and hypophosphorous acid. It would be interesting to know how far the salts formed by these last-mentioned acids might take the place of phosphates; or, in other words, to what degree an artificial soil formed of phosphite and hypophosphite of lime would be fertile. On this point, my experiments have never been doubtful: their answer has always been in the negative. In a soil of this nature, the seeds germinate, but the vegetation shows signs of weakness and poorness, and the death of the plant soon follows. It is so invariably, and appears fatal to plants grown under these conditions. I will give an example.

1861.—*Cultivation of Wheat.*[†]

Dry Product.	Phosphate of Lime. Grms.	Phosphite of Lime. Grms.	Hypophosphite of Lime. Grms.
Straw and roots ..	16·72	3·40	1·40
Grain	4·27	0·22	0·00
	20·99	3·62	1·40

One can easily form conjectures to explain the passivity of phosphite and hypophosphite of lime; but, instead of yielding to this temptation, I thought it more useful to inquire if results of the same kind could be produced with other compounds. Nitrite of potash, which corresponds to phosphite, experimented with for this purpose, shows an action still weaker than the nitrate. The functional incapacity of phosphites and hypophosphites ceases, then, to be an anomaly and an exception. It depends on a general law well worthy of being explained by the results which are manifested.

1861.—*Cultivation of Wheat.*

	0·110 grm. of Nitrogen in the state of	
Dry Product.	Nitrate of Potash. Grms.	Nitrite of Potash. Grms.
Roots and straw ..	16·55	6·97
Grain	4·27	1·07
	20·82	8·04

1861.—*Cultivation of Buckwheat.*

Roots and straw ..	8·35	3·60
Grain	3·13	1·74
	11·48	5·34

1861.—*Cultivation of Wheat.*

Roots and straw ..	5·00	2·00

Is a certain degree of resemblance in the form, composition, and chemical properties of bodies, as the resemblance between phosphites and nitrites, indicative of corresponding or analogous functional capacities? To dissipate my doubts on this subject, it appeared to me that salts of ethylamine and methylamine, compared with ammoniacal salts, ought to offer unhoped-for resources. The nature of these remarkable substances is too well known for it to be necessary to describe them fully here. Ethylamine and methylamine are derived from ammonia by the substitution of groups C_4H_5 and C_2H_3 for one equivalent of hydrogen, H. These two products possess, like ammonia, the most powerful basic properties. All leads us to think that in them nitrogen has preserved its original position with regard to the other elements. The following formulæ show more strikingly the close connection of these substances with ammonia :—

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[*] Priestley, "Experiments on Different Kinds of Air." 18mo Berlin. Preface, p. 13.

[†] The soil was of calcined sand, with the addition of 0·110 grm. of nitrogen in the state of nitre, and all the minerals necessary to vegetation in the form of a multiple silicate of lime, potash, magnesia, and iron.

Ammonia.	Ethylamine.	Methylamine.
$N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.$	$N\left\{\begin{matrix}H\\H\\C_4H_5\end{matrix}\right.$	$N\left\{\begin{matrix}H\\H\\C_2H_3\end{matrix}\right.$

Like medals of different metals struck from the same die, these bases, though of a different elementary composition, are, nevertheless, of the same chemical type. Saturated with hydrochloric acid, and employed in a manner to represent the same quantity of nitrogen, all these exert exactly the same action on vegetation. The results are so similar as to be practically identical.

1862.—*Cultivation of Wheat.*

(Seed, 22 grains.)

Dry Product.	0·110 grm. of Nitrogen in the state of Chlorhydrate.		
	Ammonia.	Ethylamine.	Methylamine.
	Grms.	Grms.	Grms.
Roots and straw ..	14·66	13·76	15·20
Grain	2·71	2·49	2·74
	17·37	16·25	17·94
Same Experiment on Barley, 1862.			
Roots and straw ..	8·77	9·45	8·20
Grain	3·08	2·66	3·22
	11·85	12·11	11·42
Same Experiment with Buckwheat, 1861.			
Roots and straw ..	6·15	4·70	5·20
Grain	1·64	0·76	1·85
	7·79	5·46	7·05

The wish to generalise the results gave me the idea to try the same experiment on urea and ethyl-urea, which are derived one from the other, as ethylamine from ammonia.

Urea.	Ethyl-Urea.
$N_2\left\{\begin{matrix}H_2\\H_2\\C_2O_2\end{matrix}\right.$	$N_2\left\{\begin{matrix}H_2\\\left\{\begin{matrix}H\\C_4H_3\end{matrix}\right.\\C_2O_2\end{matrix}\right.$

But here, to my great surprise, the effects on vegetation were quite different. Urea is a useful and active product; ethyl-urea, on the contrary, is neutral and passive. With the help of urea, vegetation is superb; as soon as ethyl-urea is substituted, its character changes, and it becomes as precarious and miserable as can be well imagined. How can these effects, so little like those of ethylamine and methylamine, be explained? Are we to see a simple anomaly, an accident, or an indication of a new and interesting order of facts to be defined and explained?

Ethyl-urea, we have said, is evolved from urea as ethylamine from ammonia, but urea itself is derived from ammonia; and if we compare the composition of these three products (urea, ethyl-urea, and ethylamine) with that of their common generator, ammonia, a great difference between ethylamine and ethyl-urea is revealed. In ethylamine, the ammoniacal type is preserved in all its integrity; one equivalent of hydrogen (one only) is expelled from the primitive compound, and replaced by the group C_4H_5. In ethyl-urea, the result on the molecular organisation of ammonia is more decided; for two equivalents of ammonia condensed into one become diatomic, three equivalents of hydrogen instead of two are displaced, and the void which thus results is filled by the groups C_2O_2, C_4H_4, which differ at the time in composition and the nature of their atomicity.

The examination of the four following formulæ renders these distinctions easier to follow :—

Ammonia.	Ethylamine.	Di-Ammonia.	Urea.	Ethyl-Urea
$N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.$	$N\left\{\begin{matrix}H\\H\\C_4H_5\end{matrix}\right.$	$N_2\left\{\begin{matrix}H_2\\H_2\\H_2\end{matrix}\right.$	$N_2\left\{\begin{matrix}H\\H\\C_2O_2\end{matrix}\right.$	$N_2\left\{\begin{matrix}H\\H\\C_4H_5\\C_2O_2\end{matrix}\right.$

Brought to the composition of ammonia, and making allowance for atomicity, we see that urea corresponds to ethylamine, whilst ethyl-urea places itself between ethylamine and di-ethylamine.

Ethylamine.	Ethyl-Urea.	Di-Ethylamine.
$N\left\{\begin{matrix}H\\H\\C_4H_5\end{matrix}\right.$	$N_2\left\{\begin{matrix}H\\H\\C_4H_5\\C_2O_2\end{matrix}\right.$	$N_2\left\{\begin{matrix}H_2\\C_4H_5\\H_5\\C_4\end{matrix}\right.$

In ethyl-urea, the substitution is pushed farther than in ethylamine. If the passivity of ethyl-urea is due to this cause, all derivatives from ammonia in which the second equivalent of hydrogen is replaced ought to become, by reason of that, inactive with regard to vegetation; and, if this conjecture be true, then it will be demonstrated that the close connection which manifests itself between the molecular type, the composition, chemical characters, and functional capacities of bodies, ceases at once, as far as their capacities when they form part of living beings, whilst their other properties remain.

If vegetation is influenced to this extent by changes of the most exquisite delicacy carried into the composition of agents with which they are put in contact, it results that its organisation offers us, in reality, a new means of exploring the order of position between the primitive elements of matter, and of aiding us in defining them.

Thanks to the valuable assistance of M. Hofmann, I have been able to submit this conjecture to the test of positive verification.

I have said on several occasions that ethylamine differs from ammonia by the substitution of group C_4H_5 for 1 equivalent of hydrogen. But the substitution may be pushed further. With regard to chloride of ammonium, for example, we can realise chloride of tetrethyl-ammonium, in which the total amount of hydrogen belonging to the initial type (ammonium, NH_4) is replaced by the group C_4H_5, equivalent for equivalent.

Chloride	
Of Ammonium.	Of Tetrethyl-Ammonium.
$N\left\{\begin{matrix}H\\H\\H\\H\end{matrix}\right.Cl$	$N\left\{\begin{matrix}C_4H_5\\C_4H_5\\C_4H_5\\C_4H_5\end{matrix}\right.Cl$

In the second compound is found essentially the type of the first. The two groups possess the same fundamental properties. However, in regard to vegetation, a radical opposition is revealed between them. Chloride of ammonium assimilates with vegetation; its action is most favourable; it soon causes the growth of cereals. Chloride of tetrethyl-ammonium, on the contrary, does not produce any appreciable effect. In this form, nitrogen, usually active in the highest degree, becomes absolutely inert. This may be judged of by a comparison of the two following results :—

1862.· *Cultivation of Buckwheat.*

Dry Product.	0·110 grm. of Nitrogen in the state of Chloride	
	Of Ammonium.	Of Tetrethyl-Ammonium.
	Grms.	Grm.
Roots and straw ..	7·51	0·79
124 seeds	2·40	0·00
	9·91	0·79

I should have considered it a great privilege to have been able to experiment on chloride of diethylamine, but, not succeeding in procuring this product with sufficient guarantee of its purity, I have had recourse to dimethyl-oxamide and diethyl-oxamide, the composition of which, brought to that of ammonium, corresponds exactly to that of diethylamine.

Ammonia.	Diethylamine.	Oxamide.	Diethyl-Oxamide
$N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.$	$N\left\{\begin{matrix}H\\C_4H_5\\C_4H_5\end{matrix}\right.$	$N_2\left\{\begin{matrix}H_2\\H_2\\C_4O_4\end{matrix}\right.$	$N_2\left\{\begin{matrix}H_2\\C_4H_3\\C_4H_3\\C_4O_4\end{matrix}\right.$

Oxamide favours vegetation; diethyl-oxamide is absolutely inert, in the same degree as chloride of tetrethyl-ammonium itself.

Cultivation of Buckwheat.

Dry Product.	0·110 grm. of Nitrogen in the state of Oxamide.	Dimethyl-Oxamide.	Diethyl-Oxamide.
	Grms.	Grm.	Grm.
Roots and straw ..	5·00	0·62	0·25
Seeds	1·50	0·00	0·00
	6·50	0·62	0·25

How curious and unexpected are these effects! Who would have predicted *à priori* the inertia of ethyl-urea, of dimethyl-oxamide, of diethyl-oxamide, of chloride of tetrethyl-ammonium, in face of the contrary properties of chloride of ammonium, of urea, of oxamide, and the salts of ethyl and of methylamine? Who would have ventured to attribute the functional incapacity of the products of the first series to a difference in the degree attained by the substitution?

Twenty-two grains of wheat, cultivated with 0·110 grm. of nitrogen in the state of urea, have produced 18 grms. of harvest. The same quantity of nitrogen, under the form of ethyl-urea, has only produced 2·67 grms. Who would have thought that a day would come when vegetation would permit us to follow with so much accuracy the progression of substitutions effected in the interior of a molecular system of which the original type remains? As to the hope that I have just expressed, to found on these experiments on cultivation a new mode of investigation to aid us in defining the true molecular state of bodies, it only remains for me to show, by an example, that I do not exaggerate the importance and utility of them.

(To be continued.)

ON BASIC CALCIUM CHLORIDE.*

By HARRY GRIMSHAW, F.C.S.

WHEN a strong solution of calcium chloride is boiled with calcium hydrate, the solution filtered, and allowed to cool, a salt separates out in long, slender, needle-shaped crystals. This salt is called in Gmelin's "Handbook," hydrated chloride of calcium and lime, or hydrated tetrahydrochlorate of lime, and, according to him, has been noticed by Bucholtz and Trommsdorf and by Berthollet, and analysed by H. Rose, who found the formula $3CaO, CaCl+16Aq$, or in present notation $3CaO,CaCl_2+16H_2O$. This is not a very simple or intelligible formula, and moreover the percentage of water found, which was 49·084, is considerably lower than that required by the formula, namely, 50·793. The salt was therefore prepared and analysed as follows:—

The solution of calcium chloride was prepared by dissolving, by heat, pure white marble in moderately concentrated hydrochloric acid until saturated. This was boiled with an excess of milk of lime for about an hour, filtered whilst hot and allowed to cool. The salt separated out, on standing, in slender, white, needle-shaped crystals, generally from one-half to an inch in length. They were sometimes obtained of not more than a quarter of an inch in length, and almost transparent, the separation not taking place until the solution was agitated. The composition of the crystals was in all cases the same, and was not affected by the length of time they were allowed to remain in contact with the liquid. The crystals, dried as quickly as possible between blotting-paper, on analysis gave the following results:—

(*a*) 0·677 grm. gave 0·273 grm. CaO.
0·442 " " 0·228 " AgCl and 0·0012 Ag.
0·307 " lost on heating 0·152 grm.
(*b*) 0·359 " gave 0·144 grm. CaO.
0·794 " " 0·2045 " AgCl and 0·0245 Ag.
1·052 " lost on heating 0·52 grm.

	Calculated for $CaO,CaOHCl+7H_2O$.	Found (*a*)	Found (*b*)	Calculated for $3CaO,CaCl_2+16H_2O$
Ca ..	29·144	28·80	28·77	28·22
Cl ..	12·932	12·86	12·794	12·522
O ..	5·829	—	—	8·465
OH ..	6·193	—	—	—
H_2O ..	45·901	—	—	—
Loss on heating	49·179	49·40	49·47	(H_2O)50·793
	100·000			100·000

The constitution of the salt is therefore expressed by the formula—

$$O\left\{\begin{matrix}CaOH\\CaCl\end{matrix}\right.+7H_2O.$$

On heating two molecules of the salt decomposed, forming $3CaO+CaCl_2+15H_2O$. The difference of the proportion of the constituents according to the above formula, and according to that assigned by Rose, is therefore that corresponding to one atom of water more or less. As the amount of water is nearly 50 per cent of the whole, this constituent will exhibit the greatest difference, namely, 1·514. Accordingly, the numbers above will be found to agree with the formula—

$$O\left\{\begin{matrix}CaOH\\CaCl\end{matrix}\right.+7H_2O,$$

which loses on heating 49·179 per cent. The number found by Rose (49·084) agrees very nearly.

The salt is perfectly stable for any length of time if kept out of contact with the air. It may be also kept unaltered in the mother-liquor for some time. In the air it decomposes, absorbing carbonic acid and water. Over sulphuric acid *in vacuo* or in air, or over quicklime, it parts with a portion of its water of crystallisation. Both these circumstances interfere with the exact drying of the salt.

With water, it decomposes into calcium hydrate and calcium chloride—

$$2\left[O\left\{\begin{matrix}CaOH\\CaCl\end{matrix}\right.\right]+2H_2O=3Ca(OH)_2+CaCl_2.$$

By the substitution of hydrobromic for the hydrochloric acid in the proparation of the salt, I expect to obtain a corresponding bromine compound.

Action of Heat upon Ordinary Aldehyd.—M. Berthelot.—The following experiment throws a new light upon the relations of carbonic oxide to common aldehyd. Aldehyd was evaporated in hydrogen so as to yield a gas formed of 5 vols. of hydrogen and 2 of aldehyd, and this mixture was heated to dull redness for half-an-hour. At the end of that time it was found on analysis to have been decomposed into carbonic oxide and formene.—*Comptes Rendus*, No. 20.

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* A paper read before the Manchester Literary and Philosophical Society, November 17, 1874.

CONFERENCE ON THE SEWAGE QUESTION.

On the 10th inst. a conference of gentlemen interested in the sewage question was held in the Hall of the Society of Arts under the presidency of Dr. Lyon Playfair, C.B., M.P., F.R.S. Among those present we observed Sir R. Torrens, Sir J. Murray, Sir Joseph Heron, Mr. A. Smee, Dr. Stenhouse, Major General Scott, Prof. Wanklyn, Messrs. W. C. Sillar, Chalmers Morton, C. Rawson, W. Hope, Bailey Denton, Baldwin Latham, C. Elcock, Evans, Fowler, &c., &c. A circular invitation had been issued to the promoters of the principal sewage processes to send in a condensed exposition of their methods. These, to abridge the proceedings, had been printed, and were distributed to all present. The subject was divided into three heads; namely:—The existence of the evil and the necessity for a remedy; the question of separating fæcal matters, manufacturing refuse, &c., from the rainfall; and lastly, the best ways of treating water-borne sewage. Each of these sections was discussed *seriatim*, no speaker being allowed to exceed ten minutes.

Mr. Chalmers Morton urged the necessity of fixing standards for refuse liquids discharged into rivers. He favoured the "Recommendations" of the late Rivers' Pollution Commission, of which he had been a member, and by way of proving that these were lenient, he stated—if we did not misapprehend him—that they would admit such water as that of the river Irwell.—(Ironical applause).

Major-General Scott concurred with Mr. Morton as to the necessity of standards, but thought it important not to outrun public opinion by too great stringency at the outset. He would compel towns, at any rate, to free their sewage from all solids and suspended matters before turning it into the rivers.

Mr. Thom, as one of the greatest river polluters in the kingdom, pointed out that manufacturers themselves would be benefitted by sensible legislation. The uncertainty of the law kept them at present in a state of uneasiness. He had at one time diverted the foul waters from his print-works from entering the river, but had received notice from his landlord that by so doing he was breaking one of the covenants of his lease and endangering his (the landlord's) rights. Many manufacturers were willing to purify their waste waters, if permitted, and protected from negligent neighbours.—(General applause).

Sir R. Torrens described the pollution of the rivers in Devon by water from the mines, and explained that there was no legal redress except it could be proved that the fish were actually poisoned. He did not think that any very severe law could be worked in the present state of public opinion, and advocated moderate measures.

Sir J. Murray stated that the river Sherborne, near Coventry, had been much improved recently.

Lieut.-Col. A. Jones advocated the separation of manufacturing from domestic refuse.

Major-Gen. Senge raised the question how the pollution of rivers had become so universal?

Mr. Evans considered manufacturing refuse easier to deal with than fæcal matter. He thought that the standards adopted should be mild and elastic, and recommended that the quantity, as well as the quality of refuse-water poured into any stream should be taken into consideration.

Sir Joseph Heron declared that the Irwell was purer on leaving Manchester than when it entered the city. He objected to water-closets, which had been forced upon the public by unwise legislation.

A motion recognising the necessity for special legislation on the treatment of sewage and refuse was moved by Sir Joseph Heron, seconded by Sir J. Murray, and carried unanimously.

In considering the second section of the subject, Capt. Liernur gave an account of his system, which dispenses with water-carriage. He pronounced irrigation unsuccessful, and reminded the meeting that sanitary works, which threw heavier burdens upon the poor, might sometimes have the very opposite effects to those intended.

Rev. Mr. Moule condemned the sewage system, and pointed out the great additional expense involved in the extra supply of water it demands.

Prof. J. A. Wanklyn pointed out the difficulty of determining with the needful accuracy such small amounts of "organic nitrogen" as 0·003—a quantity far within the limit of experimental error. He would consider it sufficient if refuse waters were rendered colourless and free from suspended matter.

Mr. Chalmers Morton rose in some excitement, and amidst cries of "Question!" and marks of disapprobation objected to the remarks of the last speaker, which, he thought, had better have been laid before the Chemical Society.

Prof. Wanklyn replied that his views had been laid before the Chemical Society six years ago, and had not been controverted.

The Chairman here stated that had he considered Mr. Wanklyn out of order he would have immediately interposed.

Mr. Baldwin Latham pointed out the practical difficulty of separating manufacturing and domestic refuse. He defended water-closets and condemned the "pail-systems" of certain northern towns in strong language. He would separate the rainfall from the sewage.

Mr. C. J. Warhæ asked why manufacturers alone should be blamed? Agriculturists and land-owners often pollute streams by the drainage from farm-yards, dung-hills, and manured fields.

Mr. C. Elcock pronounced water-closets most ingenious machines for poisoning, and defended the pail-system.

Mr. Alderman Taylor (Rochdale) likewise defended the pail-system, and made an attack upon the landed interest, whose greediness, he said, rendered irrigation costly.

The third division of the subject being now introduced, Mr. C. Rawson pointed out that every good sewage-system should fulfil four conditions. It should produce a safe effluent; it should create no nuisance in its operations; it should use no article or process calculated to injure the manurical value of the sewage matters; and it should be economical in working. Independent testimony, he contended, proved that all these conditions were fulfilled by the A B C system.

Mr. Jones (Ealing) urged the claims of the old lime-process.

Col. Hope, V.C. thought that in the opinion of competent men of science, sewage could be properly purified only by irrigation or passage through earth.

Mr. A. M. Fowler spoke of the difficulty of manufacturers treating their refuse separately. As a totally disinterested party he corroborated Mr. Rawson's remarks on the A B C process, stating that he found fishes survived in the A B C effluent longer than in Leeds town water.

Mr. W. C. Sillar, in a short but effective speech, which was loudly applauded, pointed out the costs of sanitary neglect.

Mr. A. Smee denounced the filthiness of grass grown on irrigation farms. He declared that vegetables manured with sewage putrefy more readily than those not so treated and that the milk of cows fed on sewage grass enters very readily into decomposition. He cautioned the public against watercresses grown in sewage.

Rev. Mr. Clutterbuck urged the necessity of separating rain-fall from sewage. He thought the A B C system difficult of execution.

Mr. Hall declared the sewage question merely one branch of a wider subject—the removal of all offensive matter from towns. He pointed out the offensive character of "dust-bins" which contain, not merely ashes and house sweepings, but a variety of putrescible matter.

Mr. Morgan (Lodge Farm, Barking) spoke of the good results he had obtained from irrigation with the effluent from the Phosphate Company's process. Had Mr. Hope's scheme for dealing with the sewage of North London been carried out the results would have been ruinous.

Mr. Bailey Denton contended that if land were made sufficiently porous fæcal matters would not attach themselves to the roots and stems of grass.

The Conference then broke up, after a vote of thanks to the President.

NOTICES OF BOOKS.

Pharmacography; a History of the Principal Drugs of Vegetable Origin met with in Great Britain and British India. By F. A. Fluckiger and D. Hanbury. London: Macmillan and Co.

This book takes a very well-defined position, and supplies what has hitherto been a desideratum in the pharmaceutical literature of England. The authors have not included in their programme either pharmacy—in the strictest sense of the word—or therapeutics. Each drug is headed by its Latin name, followed by such synonyms as may be required for perfect identification, together with its English, French, and German designation. The botanical origin of the substance is next examined, and the locality of its growth or production is given, but as a rule no attempt has been made to furnish botanical descriptions of the plants in question. The authors then, under the head of *history*, trace the introduction of each substance into medicine, "and to bring forward other points in connection therewith," not hitherto much noticed in any recent work. Upon this follow the formation, secretion, or method of collection of drugs, and a description of its characteristics and microscopic structure. Next follows the chemical composition, under which head, however, it has been no part of the authors' plan to supersede reference to standard chemical works. Further headings touch on production and commerce, adulterations, and substitutes.

An undertaking so difficult, extensive, and complicated involves no small amount of labour and research. These the authors have evidently not spared. The book bears the impress of thoroughness and accuracy, and supplies, to the best of our judgment, much valuable information for which the student might elsewhere search long and vainly. To medical men, pharmaceutical chemists, and drug merchants it will prove an inestimable work of reference.

On the Use of Strychnine in Epilepsy and Kindred Nervous Affections. By Walter Tyrrell, M.R.C.S. London: R. Hardwicke.

This pamphlet, as the title alone intimates, is strictly medical in its character. The author gives a brief account of the seat, cause, and treatment of epilepsy, and appends a number of cases. We have no doubt that it will be found interesting and suggestive by his professional brethren.

Introductory Address at St. Georges' Hospital, October 1, 1874, on the Art and Science of Medicine. By W. Howship Dickinson. London: Longmans, Green, and Co.

That this address should have been published, as we are told on the title page, at the request of the resident medical officers and students of the hospital, is not surprising, for it contains words of wisdom not a few. Of pathology the author says:—"Like the age it is becoming materialist. Functional or unsubstantial diseases are flitting before the microscope like ghosts at sunrise. Nervous disorders, the most evasive of all, are becoming tangible. Insanity is no longer a disease of the mind, but of the brain; the changes are none the less real because they are small and numerous. One man may be battered with a bludgeon, another stung to death by pismires, and the injury be as material in one case as the other." We will make no further extracts, but merely say that these forty pages, quaint, quiet, but thought-exciting, might be advantageously read by every man of science.

CORRESPONDENCE.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

Sir,—I have little time to devote to this question, yet Mr. Smith's letter in the Chemical News vol. xxx., p. 261, exacts a few words.

I think Mr. Smith will admit, that should the sulphide in the char be admitted as *ferrous*, its constitution will be that of a *ferrous monosulphide*, FeS, not ferrous disulphide, FeS_2; and that when FeS is acted upon with *dilute* HCl, the whole of the sulphur will be cast off as H_2S conformably with the reactions indicated in the formula—

$$FeS + 2HCl = FeCl_2 + H_2S.$$

If, on the other hand, strong HCl should be employed, some of the S would be set free, owing to the influence of various agencies, in which case the sulphur so produced would necessarily be recovered by exhausting the dried mass with CS_2.

The adoption of the latter course in the analysis of chars, not only complicates the work, but is, in my opinion, unchemical and leads to error.

Need I tell Mr. Smith that I do not follow it, and that unless the char be treated *ab initio* with *strong* HCl, no sulphur will remain for extraction with CS_2.

In example 2 of Mr. Smith's letter, a grave error is stated. If the calcic sulphide were heated to the *melting-point* in the process of re-burning the char, I would cede that Mr. Smith is right; but it is not so heated, and the energy of the calcium in the absence of fusion heat, or menstruum of any kind, binds the sulphur to itself.

In all good faith, I advise Mr. Smith to reconsider his work, and see if he really does not produce the very FeS he speaks of by his method of operations.

I am inclined to think he does, just as the free sulphur he speaks of is the result of the action of an unsuitable reagent.

Martin Murphy.

The Liverpool College of Chemistry,
December 5, 1874.

IRON IN CHAR.

To the Editor of the Chemical News.

Sir,—I observe in the Chemical News a communication from the pen of Mr. R. Frazer Smith, F.C.S., upon the presence of iron in animal charcoal, in which he modestly *advocates* the advantages which are to be derived from the use of the "classical" permanganate of potassium process.

Allow me to inform your correspondent that I had the honour of advocating this very same thing, some few months ago, in a communication which I contributed to your periodical upon the "Analysis of Animal Charcoal," and which was afterwards copied into the *Sugar Cane*, and subsequently appeared in abstract in the *Journal of the Chemical Society*. In all of these my paper reads thus:—"The oxide of iron, which is very constant in amount in new and old char, is best determined volumetrically by dilute standard solution of the potassic-anhydro-chromate (Penny's process); *or, better, by dilute standard solutions of the potassic permanganate*, using

0·5 grm. $KMnO_4$ in 1 litre distilled water," &c. Now, I have used the process for nearly three years in estimating this constituent in many samples of char which I have had occasion to analyse, and yet, after having advocated its great advantages publicly, through your columns, we find your correspondent, Mr. Smith, *only now* advocating processes for the analysis of char which I have myself done *long ago*. Again allow me to say that the iron in char does not exist as Fe_2O_3, as your correspondent's analysis would lead them to believe, but as FeO, *vide* Crookes's "Manufacture of Beet Sugar," page 165. "The iron is always in a state of *protoxide*, faint traces of peroxide excepted," &c. More than that, allow me to inform your correspondent that he has never yet estimated *all* the moisture in char, if he only dries his sample in water-bath.

In my paper, I recently advocated that *all* the moisture *was not* expelled at water-bath heat, and that it required a temperature varying from 160—180° C. to effect all the expulsion of the moisture, and, further, no organic matter is driven off, nor need be. And must I, of necessity, quote Fresenius, to impress these facts strongly upon the minds of your readers?—"Analysis of Bone-Black (General Process).—Dry 2—3 grms. at 160—180° C. The loss in weight is *moisture*."* Here is a statement which, word for word, confirms my views upon this point, not new, but made *long ago* by the highest authority upon analytical chemistry. It would seem as if Mr. Smith had never read Fresenius nor Crookes upon the "Manufacture of Beet Sugar," and many other authorities on bone-char. In conclusion, I must say that I feel highly indebted to Mr. Martin Murphy, of Liverpool, for coming forward, and "liberalising" my views upon the chemistry of this substance. That gentleman will perhaps accept my best thanks in return.—I am, &c.,

G. C. Stewart, F.C.S.

Greenock, Nov. 30, 1874.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

Sir,—I think I have found out the source of T. A. R.'s difficulties with respect to his confusion in the names of minerals. To quote your correspondent's words in the Chemical News, vol. xxx., p. 238, he says:—"I think I have analysed every mineralogical treatise in the English language, from Jeffries, of 1751, to the present time, resolutely posting my ledger all the while." T. A. R. seems to forget that there are other languages besides English, and might have saved himself all this trouble by studying German works on the subject. However distinguished we may be in geology, in mineralogy we may be truly said to be only in our infancy, and immeasurably behind Germany.

In reply to some of the questions stated by T. A. R., I may say that the Beaumontite of Jackson is no definite mineral, and, therefore, cannot be said to exist. The Herrerite of Herrara, also, does not exist, unless the collection in the British Museum can produce a specimen. Volborthite has never yet been properly analysed, and is no doubt very nearly related to Kalkvolborthite. The latter name should be spelt with the letter "v" after the syllable "kalk, and not with the double "o," as it has several times been erroneously printed; "kalk" is the German word for calcium oxide, and, as Kalkvolborthite contains from 12·28 to 17·40 per cent of this oxide, the name is very appropriate. The Polyhalite of Stromeyer, and that of Berthier, are identical. Two analyses were made by MM. Dexter and Jenzsch, of the *very same specimen* analysed by Berthier—one piece having a grey colour, the other light red. It will be seen at once, from the results given below, that Berthier was entirely wrong, and Stromeyer right. Hence, only one Polyhalite exists.

		Polyhalite de Vic.			
				Berthier.	
	Stromeyer.	Dexter (Grey).	Jenzsch (Red).	1.	2.
$CaSO_4$ ..	44·74	44·72	44·11	40·0	52·2
$MgSO_4$ ..	20·03	19·08	19·78	17·6	2·5
K_2SO_4 ..	27·70	27·77	25·87	—	—
Na_2SO_4 ..	—	—	1·69	29·4	21·6
NaCl ..	0·19	0·44	0·24	0·7	18·9
Fe_2O_3 ..	0·34	0·59	1·01	4·3	5·0
H_2O ..	5·95	7·40	6·16	8·0	—
	98·95	100·00	99·38	100·0	100·2

Stibiconite, Stibiconise, and Stiblite are the same thing; the proper name for the mineral being Stiblite. Stibium, Stibnite, and Stibine are also the same thing; the proper name being Antimonite. Stilbite is not an Antimony mineral at all, and is known to modern mineralogists as a well-defined member of the Zeolite group. As to Stillolite, no such name is known to modern mineralogists.

Hoping your correspondent's mind will at last be set at rest,—I am, &c.,

Charles A. Burghardt, Ph.D.

The Owens College, Manchester,
December 7, 1874.

THE CONSTITUTION OF MUREXIDE.

To the Editor of the Chemical News.

Sir,—With a desire to publish a long-prepared study of urea and ureide derivatives, I may be allowed to highly compliment Mr. Reoch on his chivalrous attempt to grapple with one of the darkest problems of organic chemistry. The hesitation on my part has arisen from an intense dissatisfaction with a very laboured effort to determine the constitution of murexide.

With a strong desire to share the view of Liebig, from which I cannot divest myself, I have, nevertheless, been compelled *pro tem.* to see things more after the manner of Prout. On either view, it does seem that murexide is a generic body, whose non-determination is a reproach to chemistry. The easy interchangeability of the mesoxyl and tartronyl radicals, and the great probability that two atoms of tartronyl ($C_6H_1O_6$) are necessary for the production of murexide, seem to suggest the possibility that a picric phenyl radical may be a result of their dedoublement or condensation; and hence would follow that we may have nitrophenyl-, cresyl-, and naphthyl-murexide. And while these have, in great measure, the peculiar dyeing properties of the actual ureide, there is also the same difficulty in isolating their hypothetical free acids.

I quite disagree with Mr. Reoch's estimate of the modern methods of research. If, for instance, two bodies − 2HO give a third body, and if the constitution of the two bodies be approximatively known, and the generic process of eliminating 2HO be well understood, then we can do much towards an *a priori* projection of the unknown constitution; after which the actual and ultimate analysis will have a double value. It is somewhat in this way that our great chemists have regarded murexide as a C_{16} body (C_8). Mr. Reoch seems to prefer that we should invert this order, and commence with analysis; and hence his determination that the body contains C_{20}, &c. His more recent analysis may be better than theirs, and conjoined with their methods might lead to corrections which might explain the confusion and barrenness of all preceding efforts; but, standing by itself and without those methods, it is simply blank knowledge.

The true purpurate, murexide, is prepared from varied tartronyl ureides; the iso-purpurates from cyanides and picric acid or its analogues; the meta-purpurates from cyanides and dinitro compounds. It is further said that the iso-purpurate of ammonia is indistinguishable from murexide, and may be used for similar dyeing purposes.

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* Fresenius's "Quantitative Analysis," 4 ed., 1865, p. 711.

With the earnest desire that further efforts may be made to resolve this intricate and useful problem,—I am, &c.,

S. E. Phillips.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 20, November 16, 1874.

The Carbonyls, a New Class of Organic Compounds; and on the True Function of Ordinary Camphor.—M. Berthelot.—The carbonyls are a subdivision of the aldehyds, and comprise three well-defined bodies—ordinary camphor, oxide of allylen, or dimethylen-carbonyl and diphenylen-carbonyl, otherwise known as diphenylen-aceton. The composition of these bodies is—

Oxide of allylen,	$C_6H_4O_2$ or $(C_2H_2,C_2H_2)C_2O_2$.
Diphenylen-carbonyl,	$C_{25}H_8O_2$ or $(C_{12}H_4.C_{12}H_4)C_2O_2$.
Camphor,	$C_{20}H_{16}O_2$ or $(C_{10}H_8,C_{10}H_8)C_2O_2$.

Suberon, $C_{14}H_{12}O_2$, probably possesses a parallel constitution. These bodies may be regarded as types of homologous series, and of a multitude of other compounds, having the same characteristic reactions. They are able to fix hydrogen, and to become converted into alcohols, and reciprocally the alcohols thus produced reproduce carbonyls by the loss of hydrogen. This general reaction the author proposes as the characteristic of the aldehyds, including the primary aldehyds, the secondary, or acetons, and the mixed aldehyds, among which are the quinones. The carbonyls may also be formed directly or indirectly by the substitution of oxygen for hydrogen in equal equivalents. The carbonyls are in themselves incomplete bodies. The fixation of the elements of water changes them into monobasic acids, and by the fixation of six equivalents of oxygen they may be transformed into bibasic acids. Camphor is distinguished from the true aldehyds by the fact that its direct oxidation does not furnish a monobasic acid comparable to the acetic. From the acetones it is distinguished by the circumstance that its oxidation yields a single bibasic acid without becoming split up into two distinct acids.

Electric Influence.—M. P. Volpicelli.—This paper requires several illustrations.

Action of an Electro-Magnet on the Spectra of Rarefied Gases Traversed by Electric Discharges.—M. J. Chautard.—This paper treats of the action which powerful magnets produce in the spectra of rarefied gases traversed by the discharge of an induction coil or of a Holtz machine. These spectra, characteristic of the matter through which the spark passes, offer, under the influence of the magnet, peculiarities very striking and special as regards number, position, intervals, and the degree of fineness of their lines. The experiments have as yet been confined to the spectra of the non-metallic bodies, taking for types the elements pointed out by M. G. Salet in the important research which he has published on this subject. Each body was enclosed in a Geissler's tube, having one part contracted and almost linear, which was placed between the poles of an electro-magnet, and at a small distance from the slit of a spectroscope. The divisions of the micrometer, previously marked upon the Frauenhofer lines, enables us immediately to convert the corresponding colours of the spectrum into the lengths of undulators. Finally, another Geissler tube quite analogous to the former, placed in view of the small reflecting prism, and outside the action of the magnet, gave a second spectrum in juxtaposition to the first so as to serve for comparison. A spark was then passed through both tubes, and the perfect agreement of the lines given by each spectrum was ascertained. This agreement ceases the moment that the magnet is set in action. Whilst one of the spectra preserves its primitive character, that yielded by the gaseous matter exposed to the influence of the magnet undergoes remarkable changes, which in case of each body present new appearances, according as the intensity and the direction of the current, and the distance of the magnet. The bodies experimented upon are hydrogen, chlorine, bromine, iodine, oxygen, sulphur, selenium, and nitrogen. The light of selenium and of sulphur under the influence of the magnet is notably diminished in intensity, so that the spectrum, very feeble at first, disappears after the lapse of a few instants. Chlorine and bromine are characterised by an increase of lustre, and by the development of fine, brilliant, numerous lines, especially in the green, the appearance or disappearance of which, on turning the interrupter, produces a perfectly magical effect. These phenomena may have a certain importance, both as regards celestial spectroscopy, and as regards the obscure relations of magnetism and light.

Note on Magnetism, and on a New "Exploseur."—M. Trève.—The author describes an electro-magnetic arrangement for exploding mines, &c., at great distances, and used during the siege of Paris.

Manufacture of Paper from Gombo, and on the Industrial Uses of this Plant.—M. Ed. Landrin.—Gombo (*Hibiscus esculentus*) is a mulvaceous plant, growing in Syria and Egypt, where it is cultivated for the sake of its fruit. The fibre is prepared for paper-making by means of special machinery in a current of water, without any chemical treatment. The paper is very beautiful and strong, and may compete with the finest papers made from pure rags.

Insalubrity of the Seine in August, September, and October, 1874.—M. Boudet.—The author gives a table of the amount of oxygen dissolved in 1 litre of Seine water at a number of places. The quantity varies from 10·42 c.c. at Rouen to 1·02 at La Briche, and 1·05 at Epinay.

Method Employed for Discovering the Most Suitable Substance for Combatting the Phylloxera at the Viticultural Station of Cognac.—M. Max Cornu.

Effects of the First Cold on Phylloxerised Vines in the District of Cognac.—M. Maurice Girard.

On Fluoren.—M. Ph. Barbier.—The author connects fluoren to phenanthren and diphenyl. He has discovered a fluorenic alcohol, $C_{26}H_{10}O$.

Bulletin de la Societe Francaise de Photographie, No 5, 1874.

At the meeting of the Society, May 1, M. Duboscq stated in a letter addressed to the President that as early as 1853 he made microscopic projections, considerably enlarged, and that by a combination of his apparatus he was able either to superpose the image of a micrometer upon the photograph, or to substitute rapidly the one for the other.

M. Dumas, President of the Commission nominated by the Academy of Sciences to prepare and examine the most exact means of observing the transit of Venus, presented to the Society a collection of memoirs, reports, and documents on this subject. This volume is a convincing proof of the important part which photography is destined to play in this great astronomical question, and of the services which it will render to all the sciences of observation. Particular mention is due to a memoir by M. Cornu on the photographic achromatism of achromatic telescopes for direct-vision by the simple removal of the two lenses which form the objective.

A variety of communications had been received on the application of photography to the observation of the transit of Venus. Ch. Zenger substitutes a concave mirror for the ordinary object-glass, a method previously, but unsuccessfully, used by Woolcott, Beard, and Secchi

Zenger has succeeded in obtaining proofs of the moon and the sun, which have been brought to the enormous size of 110 English inches.

In connection with the presentation of a number of beautiful maps by the General Direction of Geographic and Geodesic Works of Portugal, it was mentioned that M. Rodriguez, the able organiser of the service, had obtained excellent results by his process.

Attention was drawn to No. 22 of the *Memorial de l'Officier du Genie*, containing an interesting memoir by Captain Javary on the use of photography for taking plans. This paper contains valuable instructions for those who wish to apply photography to the military art and to surveying.

In the same paper Captain de la Noe treats on the advantages of ferrocyanide of iron paper for the rapid multiplication of plans.

M. Castellani gives, in the *Revista Photografica*, an original process for intensifying. To give the wished-for intensity to a proof developed by means of iron, it is merely needful to blow upon the plate submitted to the developing-bath by means of a glass tube half a centimetre in diameter; a small piece of sponge is fixed at the end of the tube to prevent the projection of saliva. A little skill is needed to give the proof uniform intensity.

Mitchell's formula for gun-cotton, said to be at once the most explosable and the most soluble in alcoholic ether, was quoted.

A discussion took place on an article by Mr. Wharton Simpson in the *Photographic News*.

M. Derogy presented a new enlarging mirror, moved by clockwork, and playing the part of a heliostat.

M. Davanne presented to the Society a travelling camera invented by M. Durand, an amateur. This apparatus is described at length, but its construction can scarcely be understood without the aid of an illustration.

M. Puttemans presented to the Society various specimens illustrating his process for transforming photographs into oil paintings, and gave an experimental illustration of the method.

M. Franck de Villecholle called attention to the yellow spots which appear on photographs, very common in some ateliers. He considers it due to a decomposition of the glue. He recommends the addition of a trace of alum.

Influence of Colour upon the Reducing Action of Light.—Carey Lea.—The author gives an account of the experiments he has carried out with per-salts of iron, bichromate of potash, ferridcyanide of potassium, and nitrate of uranium. He finds that corallin increases the sensibility of chloride of silver for all the rays, especially the blue and the violet. Rosanilin increases the sensibility for the same two rays, but lessens it for all others. Aniline blue lessens the sensibility for the green, augments it for the yellow, and is without action for the rest. Aurin produces a general decrease of sensibility. Mauvein and aniline green have no action. Litmus reddened by acetic acid greatly augments the action of the blue and the violet.

Heliochromy.—Ducos du Hauron.—A paper on the production of photographs in their natural colours. The author's views coincide with those of M. C. Gros.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 6, 1874.

Reflection of Light from the Surface of Isotropic Bodies.—G. Lundquist.—The first portion of a long and important memoir, consisting to a great extent of mathematical formulæ, and incapable of useful abstraction.

Medium in Electric Induction.—Dr. H. Brongersma.—The object of this paper is to justify Faraday's theory of electric action without contact (Faraday's "Experimental Researches," 1669 and 1670), against the objections raised by Riess and others.

Communications from the Mineralogical Institute of the University of Strasburg.—These communications include a notice—(1) *Crystalline Form and Thermo-Electric Properties of Speis-cobalt*, by Paul Greth. The results arrived at are that speis-cobalt shows in general merely the crystalline forms of the regular system, common to its holohedric and hemihedric section with parallel surfaces, namely, $\infty O \infty$, O, ∞O, 2O2, whence it has been hitherto considered as holohedric. Other surfaces are rarely found such as $\infty O3$, $\infty O5$, $\infty O10$, and hexakis-octahedra, but these appear always hemihedrically as pentagon dodecahedra and diakis-dodecahedra. Hence speis-cobalt forms pentagonal-hemihedral crystals. This mineral has the physical peculiarity that the majority of its crystals are thermo-electrically negative to copper, whilst a portion are positive. This peculiarity has been detected in no other body except iron-pyrites, and glance-cobalt, two minerals whose chemical constitution is analogous to that which may be deduced from the analyses of speis. The hemihedrism and the thermo-electric properties of speis-cobalt prove that it is perfectly isomorphous with iron-pyrites and glance-cobalt, and that its chemical composition is, therefore, $(Co,Ni,Fe)AS_2$.

(2) *Chemical Composition of Leadhillite.*—Dr. C. Hintze.—The author proves that leadhillite is not $PbSO_4+3PbCO_3$ as formerly assumed, but $2PbSO_4+4PbCO_3+PbO+2H_2O$. The supposed new mineral, maxite, discovered by Prof. Laspeyres in the lead mine Mala-Calzetto, near Iglesias, in the island of Sardinia, is identical with leadhillite.

(3) *Crystallographic Examination of Compounds of Aldehyds with Hydrocarbons of the Aromatic System.*—Dr. C. Hintze.—This paper does not admit of useful abstraction.

(4) *Twin-Growth of Willemite.*—Dr. A. Arzruni.—The forms found in certain crystals are ∞R and $\frac{2}{3}R$, as may be proved by measurement. The twin surface is a plane of the pyramid of the second order, $\frac{2}{3}PQ$.

(5) *Optical Examination of Hydrated Oil of Turpentine.*—Dr. A. Arzruni.

(6) *Optical and Crystallographic Investigation of certain Bodies like Urea.*—Dr. A. Arzruni.

(7) *Two Isomorphous Derivatives of Benzol.*—Dr. A. Arzruni.—These three papers are not adapted for abstraction.

State of Aggregation of the Solar Spots.—F. Zöllner.—The author maintains that the spots are solid slag-like masses floating on the liquid surface of the sun.

On Ozone.—T. Andrews.—A paper read before the Royal Society of Edinburgh.

Measurement of Terrestrial Magnetism.—Dr. K. Braun.—The first portion of a memoir on the precautions needful to ensure accuracy in the determination of the three magnetic elements.

Polarisation of Zodiacal Light.—Prof. A. W. Wright.—From the *American Journal of Science*, vol. vii.

Diffusion Between Dry and Moist Air.—E. Reusch.—A description of a diffusion-tube with a plate of hydrophane.

A Diffraction Grating for Spectroscopes.—From the *American Journal of Science*, vol. v., p. 472.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 8, 1874.

M. Moigno, speaking of Prof. du Bois-Reymond, calls him "le plus Prussien des savants Prussien."

Observations on the Construction and Maintenance of Lightning Conductors.—A notice of a work by R. Francisque-Michel. The editor describes the conductors of Paris generally as being in a deplorable condition, calculated to endanger rather than protect the buildings to which they are attached. Several improvements are recommended, which are shown in the accompanying illustrations.

Nos. 9 and 10, 1874.

This double number is chiefly taken up with a report of Dr. Tyndall's Belfast speech.

Maps with Soluble Ferro-Prussiate.—Paper prepared with cyanate of iron is recommended for reproducing plans, maps, &c. After exposure it is washed with water, which fixes the design.

No. 11, 1874.

This number opens with a letter from the editor to Dr. Tyndall, of a character utterly unfit for our columns.

The yield of the gold mines of French Guayana for the year 1873 is officially stated at 832·344 kilos.

Reimann's Farber Zeitung, No. 39, 1874.

This number contains a notice of M. Schlumberger's aniline black; receipts for dyeing a fast grey, a sea-green, and a fast green on woollen yarn; a straw-colour on cotton piece goods; a brown, a violet-blue, a blue, and a red on horse-hair; a blue, a royal blue (which, however, contains no prussiate), and an aniline blue on felt hats; instructions for ungumming silk, which is directed to be worked in two soap-baths, the first containing 4 ozs. and the second 3 ozs. per pound of silk. There are further receipts for an orange resist for vat-blues, and for a red, white, and black on calico and muslins.

Removal of Nitric Acid Stains.——These well-known yellow stains can be removed either from the skin or from brown or black woollen garments, by moistening the spots for a while with permanganate of potash, and rinsing with water. A brownish stain of manganese remains, which may be removed from the skin by washing with aqueous solution of sulphurous acid. If the spots are old they cannot be entirely removed.

Oxide of Chrome as a Mordant.—In the *Journ. de la Soc. Indus. de Rouen* M. Gros-Renaud describes the action of chromic oxide as a mordant. It gives with madder a reddish colour; with logwood, black or grey; with the red woods, brown and lavender; with cochineal a crimson; and with yellow dyes a yellow. With catechu brown two yellow tones are produced. If chromic oxide is steamed it does not lose the property of taking up colour from dye solutions. Acetate of chrome is therefore successfully used as a mordant for steam colours. Chrome-alum has been found inapplicable for this purpose. Nitrate of chrome gives very dark shades, it does not weaken the fibre, and is not deliquescent. The solution of the acetate of chrome, obtained by double decomposition of sulphate of chrome and sugar of lead, is more stable than acetate of alumina. Its solutions are not decomposed by boiling, but if steamed it gives up its base to the fibre. It does not coagulate thickeners at common temperatures. To fix the hydrated sesquioxide of chrome upon tissues, they are dyed or printed with the solution, and then winced through a weak soda-bath (3° B.) at 48° C.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès Schaerbeek, Brussels.) March 13, 1874.—No. 911. To procure the carbonates of baryta and strontia, alkaline earthy chlorides are dissolved in water to 12 or 15° B., and the solution, whether of the chloride of barium or the chloride of strontium, is mixed with hydrate of magnesia in a vessel, which is afterwards closed. The mixture is kept in continual agitation, and subjected to the action of a current of carbonic acid, which being absorbed by the magnesia forms a carbonate of this base, and by the employment of an excess of carbonic acid the decomposition is rapidly effected, and the alkaline earths produced free from carbonate of magnesia. In practice, the treatment of the alkaline earthy chlorides by magnesia and carbonic acid is effected in two operations. In the first, the magnesia is in excess, which gives when the reaction is terminated a liqdor containing exclusively chloride of magnesium, which is decanted, and a precipitate obtained consisting of a carbonate of the alkaline earth, and the magnesia employed in excess in a carbonated state, which excess is neutralised in the second operation by an additional quantity of the alkaline earthy chloride. The liquor containing the chloride of magnesium is concentrated by evaporation, and the hydrated chloride of magnesium submitted to the action of steam superheated to about 300° C. without pressure, so that it becomes completely decomposed, and is in the condition to be rapidly hydrated and carbonated. To manufacture caustic baryta and strontia from their carbonates, the carbonate is mixed with carbon or chalk, and the mixture, whether subjected or not to the action of superheated steam, is heated in a regenerating or reverberatory furnace.

Improved means of and compositions for preserving wood and other materials and structures, and for rendering them fireproof. Cristoforo Muratori, Burton Crescent, Middlesex. March 14, 1874.—No. 931. This relates to compositions in which waste skin cuttings, alum, gum, and water form a body to be mixed with wood, stone, metal, or other body in a state of powder for covering corresponding bodies or others and coating them to resist the action of fire.

Improvements in the purification of gas and gas-liquor. F. C. Hills, manufacturing chemist, Chemical Works, Deptford, Kent. March 14, 1874.—No. 934. This invention relates to a process described in the Specification of Letters Patent, No. 1369, 1868, and consists of certain improvements in purifying gas-liquor and in using gas-liquor for the purification of gas. The crude gas-liquor is run either direct or through a scrubber to a still in which the said liquor is kept at a temperature of about 180°, whereby carbonic acid, sulphuretted hydrogen, and ammonia are driven off. These products pass from the still up through the said scrubber, the greater part of the ammonia being condensed and carried back to the still by the descending gas-liquor when the said liquor is passed through the scrubber, while the sulphuretted hydrogen and carbonic acid gases escape at the upper part of the scrubber with a little ammonia, which latter may be taken up by water, acid, or other suitable agent. The carbonic acid and sulphuretted hydrogen may be passed through oxide of iron to collect the sulphur. The crude gas-liquor before being run into the still may be kept for some time at a temperature of about from 160° to 170°, and the sulphuretted hydrogen then given off may be used for making sulphide of lime or sulphide of ammonia. The gas-liquor, treated as described, may be used for purifying gas. Crude gas-liquor is made to combine with more of the carbonic acid combined with gas, and thus to free the said gas from such acid by passing such gas direct from the hydraulic main at a temperature of 160° into a scrubber.

Improvements in the production of tannin. Paul Phillippe Francois Miches, Leadenhall Street, London. March 18, 1874.—No. 957. This invention relates to a process for the production of tannin from tannin-bearing plants, trees, fruits, leaves, barks, or extracts thereof. The tannin is first extracted from the said plants, trees, or other substances by maceration or decoction in water, to which is added soluble salts of magnesia or lime, or sea-water may be used, or a solution of common salt, or of sulphate of soda. The extract obtained is treated with alkali or with alkaline earths, or their soluble carbonates or hydrates, for the precipitation of the tannin, the precipitate is collected and washed, and is then ready for use in a moist or dried state. When used for dyeing it is suspended in water with the addition of a small quantity of acid, whereby the precipitate is dissolved, and a solution of tannin is obtained in a more or less concentrated state.

Improvements in the manufacture of artificial butter. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Louis Dordron, Alexandre Villeron, and Jacques Auguste Bezinge, all of Paris.) March 25, 1874.—No. 1049. This artificial butter is composed of fresh beef and veal suets, milk, and oil in suitable proportions, and prepared by working up in a mixer.

Improvements in the manufacture of waterproof plates or panels applicable for sheathing and roofing, and in the manufacture of packing and other cases, tanks, hollow spheres, cylinders, and such like, from paper or other ligneous tissues prepared with cupro-ammonium. Yorick Jones Murrow, Tavistock Square, Middlesex. March 26, 1874.—No. 1063. The claims to this Complete Specification are—(1) The mode herein described of manufacturing waterproof thick tissues from cupro-ammonialised paper or other ligneous material by the alternation of wet and dry sheets; also the application of such waterproof tissues to the various purposes herein specified. (2) The mode herein described of preparing millboard and such like thick paper tissues prior to forming slabs or plates from them. (3) The manufacture of packing-cases, tanks, hollow spheres, cylinders, tubes, boxes, and such like from the waterproof tissues substantially as herein described. (4) The moulding of cupro-ammonium-prepared tissues into various hollow forms by subjecting such tissues to internal fluid pressure whilst they are held within an external mould of the desired form.

MEETINGS FOR THE WEEK.

MONDAY, 21st.—Medical, 8.
—— London Institution, 5.
TUESDAY, 22nd.—Civil Engineers, 8. (Anniversary.)
—— Anthropological, 8.

TO CORRESPONDENTS.

Equivalent.—Before inserting your letter we must receive your name and address; not, however, for publication.

J. W.—Send the particulars for our perusal.

G. P.—Please explain more clearly your requirements.

THE CHEMICAL NEWS.

Vol. XXX. No. 787.

EXPERIMENTAL RESEARCHES ON VEGETATION.

The Employment of Vegetation to Ascertain and Define the Molecular State of Bodies;

The Analysis of Vegetable Earth by Rational Methods of Culture.

By M. GEORGES VILLE.

(Concluded from page 280).

II.—For a long time, chemists have ignored, or misunderstood, the true nature of urea. The multiple, and sometimes contradictory, reactions that this body presents have led to much divergence of opinion and to different interpretations. Urea changes with wonderful facility into carbonate of ammonia. The simple contact of a nitrogenous matter in the act of decomposition is sufficient for that. If we add that urea possesses the composition of carbonate of ammonia, less four equivalents of water, it is not surprising that certain chemists have thought of deriving one from the other. However plausible it seems, this conjecture is still open to criticism. When a solution of cyanate of ammonia is evaporated, the liquid deposits crystals of urea. If a mixed solution of urea and nitrate of silver is concentrated, a mixture of nitrate of ammonia and cyanate of silver is pruduced. The reactions are of a nature to justify the opinion of those who admit the existence of cyanic acid in urea. But, contrary to the properties of ordinary salts, urea possesses the power of combining with acids, and forming with them true salts, or at all events compositions which greatly resemble them. Thus, certain chemists have considered urea as the oxide of a radical compound, participating at the same time in the properties of ammonia and cyanogen. In this supposition, urea becomes a double oxide of cyan-ammonium and hydrogen—

$$\left.\begin{matrix}NH_3CyO\\HO\end{matrix}\right\}$$

It is true that the uncertainty there has for some time been felt on the true nature of urea is now likely to cease. Its production by means of chloro-carbonic acid, explained by the new theories on the amides introduced into science by M. Dumas, more recently by the remarkable works of M. Wurtz on the production of compound ureas, is favourable to the idea that urea is really di-ammonia, in which the radical carbonile replaces a double equivalent of hydrogen, H_2. But, with all deference to the opinion which ought definitely to prevail among chemists, let us fix, by their symhols, the three formulæ which we have just referred to, and, without any pre-conceived ideas, let us ask vegetation to decide.

Urea.		
Liebig.	Gerhardt.	Wurtz.
Abnormal Cyanate of Ammonia.	Oxide of Cyan-Ammonium.	Di-Ammoniac Carbonile.
$C_2O_2N_2H_4$	$\left.\begin{matrix}NH_3CyO\\HO\end{matrix}\right\}$	$N_2\left\{\begin{matrix}H_2\\H_2\\C_2O_2\end{matrix}\right.$

Urea produces on vegetation a most favourable and active influence. Its effects equal those of ammoniacal salts. If cyanic acid enters into its composition, this product itself ought to be as active as ammoniacal salts. But see how different are the results. The cyanates do not exercise an appreciable influence on vegetation. Under this form, nitrogen is not assimilated; its passivity is absolute, as may be easily seen by the following results:—

1862.—*Cultivation of Buckwheat.*

Dry Product.	0·110 of Nitrogen in the state o	
	Urea.	Cyanate of Potash
	Grms.	Grms.
Roots and straw ..	7·93	1·43
Seeds	2·44	0·00
	10·37	1·43

After this proof of the neutrality of cyanates, is it right to consider cyanic acid amongst the constituents of urea? The idea of representing urea as oxide of cyan-ammonium and hydrogen, adopted by Gerhardt in his great "Treatise on Organic Chemistry," does not accord better with the testimony of vegetation. Numerous experiments have shown me that, in an artificial soil of calcined sand, the cyanides and ferrocyanides were neutral, or decidedly noxious, whilst the neutrality of cyanates was already known to me.[*]

We must rest, then, in the supposition that urea belongs to an ammoniacal type, from which, however, it differs by its double atomicity and by the substitution of the radical C_2O_2 for H_2.

If such is really the true nature of urea, its action on vegetation explains itself, and I add that chlorhydrate of ethylamine having produced as much effect as sal-ammoniac, this similarity of action ought to extend to urea itself; and experience confirms this supposition in the most satisfactory manner.

1862.—*Cultivation of Wheat.*

Dry Product.	0·110 of Nitrogen in the state of	
	Urea.	Sal-Ammoniac.
	Grms.	Grms.
Roots and straw ..	15·07	14·66
Grains	2·43	2·71
	17·50	17·37

1861.—*Cultivation of Wheat.*

Roots and straw ..	15·49	14·97
Grains	2·19	2·45
	17·68	17·42

Consequently the formula—

$$N_2\left\{\begin{matrix}H_2\\H_2\\CO_2\end{matrix}\right.$$

is exactly that which best explains urea.

If this deduction be thought premature, and the test on which it is founded incomplete and insufficient, we have the means of controlling and re-affirming it.

Oxamide is derived from oxalate of ammonia exactly as urea from carbonate. Oxamide and urea are formed in the same manner, by the condensation of two equivalents of neutral salt, followed by the elimination of four equivalents of water.

$$\overbrace{2NH_4O,CO_2-4HO}^{\text{Carbonate of Ammonia.}} = \overbrace{N_2\left\{\begin{matrix}H_2\\H_2\\C_2O_2\end{matrix}\right.}^{\text{Urea.}}$$

$$\overbrace{2NH_4O,C_2O_3-4HO}^{\text{Oxalate of Ammonia.}} = \overbrace{N_2\left\{\begin{matrix}H_2\\H_2\\C_4O_4\end{matrix}\right.}^{\text{Oxamide.}}$$

Urea and oxamide result from a similar method of generation; their constitution corresponds on all points.

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[*] This proof could only be defined after having experimented on cyanogen compounds, such as cyanamide; thus it is a point still in reserve.

Ought not oxamide, therefore, to exercise a favourable influence on vegetation, and its effects be equal to those of oxalate of ammonia?[*] But on this question experiment has answered as follows:—

1861.—*Cultivation of Buckwheat.*

Dry Product.		0·110 grm. of Nitrogen in the state of	
		Oxalate of Ammonia.	Oxamide.
		Grms.	Grms.
Roots and straw	..	5·67	5·00
Seeds	.. .. ..	1·17	1·05
		6·84	6·05

1861.—*Cultivation of Wheat under the same conditions.*

Roots and straw	..	8·30	8·35
Seeds	.. .. ..	2·08	1·84
		10·38	10·19

Thus is justification found for what I have said at the commencement, that vegetation offers us unhoped-for resources in penetrating the molecular state of bodies, even to giving to their formulæ one more degree of accuracy. Thus, the first part of the programme which I have placed before you is found complete.

In a second article, I shall show how it is possible, by an extension of the same methods of experimentalism, to discover in the soil the presence of phosphate of lime, potash, lime, humus, and active nitrogenous compounds—in a word, all the regular agents of vegetable production—and how we are authorised to found, on the knowledge of these results, a practical method of analysis for the use of agriculturists.

ON THE EFFECT OF HEAT ON IODIDE OF SILVER.[†]

By G. F. RODWELL, F.R.A.S., F.C.S.

Professor Clerk Maxwell, when discussing the expansion of matter by heat ("Theory of Heat," p. 8) says, "The body generally expands (the only exception among solid bodies, as far as I am aware, is the iodide of silver, which has been found to contract as the temperature rises.)" M. H. Fizeau, speaking of the same substance ("Nouvelles Observations relatives à l'iodure d'argent") writes as follows:—"Ce corps, en effet, parait offrir l'exemple d'une inversion complète des phénomènes ordinaires de la dilatation par la chaleur, car son volume diminue très-certainement pendant l'échauffement et augmente pendant le refroidissement."

It was thought that a substance possessing so marked a property would probably exhibit peculiarities of molecular structure, and the following experiments were made in order to determine whether such peculiarities exist, to note the effects of higher temperatures upon the iodide than those employed by Fizeau (which in no instance exceeded 100° C.), and to determine the point of maximum density of the iodide. The phenomena which most closely approximate to those assigned to the iodide of silver when heated, are to be found in the case of the anomalous expansion of ice and bismuth, and a few other substances which at the moment of fusion, and for a few degrees above their point of solidification, exhibit contraction on being heated; but in these instances we have to bear in mind that a change of state is simultaneously effected, or about to be effected in the substance. Again, certain crystals contract in the direction of one of their axes on the application of heat, but they expand in the direction of another axis, and the total expansion is greater than the contraction, so that they possess a positive coefficient of expansion. Garnets and a few other crystals undergo an increase of sp. gr. on being strongly heated, and slowly recover their original density.

The iodide of silver, on the other hand, when far removed from the point at which it undergoes any change of state, appears to exhibit contraction, to possess what M. Fizeau calls a "negative coefficient of expansion;" and this is the more remarkable when we remember that the chlorides, bromides, and iodides, of potassium, sodium, and ammonium, and the chloride and bromide of silver expand considerably when heated, more so indeed than the most expansible metals, such as lead, tin, and zinc. The contraction of the iodide of silver is, according to Fizeau, quite regular between −10° C. (14° F.) and +70° C. (158° F.); and he calculates that the contraction is equal to about $\frac{1}{2400}$ of its volume at 0° C. for 100° C.; or, again, equal to $\frac{1}{6}$th the expansion of platinum for 100° C. He also found that a large hexagonal crystal exhibited a very considerable contraction in the direction of the axis of symmetry, while a slight expansion was produced in a direction normal to the axis of the crystal.[*] The contraction was observed in the case both of the crystal, a confused crystalline mass, and an amorphous mass produced by strongly compressing the precipitated iodide until it became a hard mass capable of receiving a fine polish, and possessing a sp. gr. of 5·569. Fizeau considers that that the iodide possesses its maximum of volume or minimum of density at a temperature, of −60° C. (−76° F.).

The iodide of silver employed in the following experiments was prepared:—(1) By precipitation. Pure iodide of potassium was added to nitrate of silver, both in dilute solution. The precipitated iodide was thoroughly washed in the dark, slowly dried, fused in a porcelain crucible, and cast into cylindrical masses, either in a warm porcelain or brass mould.[†] (2) By dissolving pure silver in strong hydriodic acid, evaporating to dryness, fusing. (3) By exposing pure silver leaf for several hours to the vapour of iodine produced by spontaneous evaporation.

Before we examine the effects of heat upon the iodide, it may be well to say a word or two concerning the action of light upon it. A considerable amount of misconception appears to exist in regard to this. Gmelin says "it turns brown on exposure to light, but less quickly than the chloride;" Miller says "it is but slowly acted upon by light;" Fizeau describes it as, "noircissant lentement à la lumière;" while Vogel ("Jahresbericht," 1863) affirms that if it be precipitated with excess of iodide of potassium it is scarcely affected by light, whereas if precipitated with excess of nitrate of silver it changes colour, but undergoes no chemical change. The general idea that it is nearly as sensitive to light as the chloride, has no doubt arisen from the fact that iodides and chlorides are known to have many points of resemblance, and that the iodide is largely used in photography; moreover we remember that a thin film of iodide of silver was the sensitive medium in the original daguerreotype. But we must bear in mind that the change produced by light is not apparent until the so-called "developing solution," which contains reducing agents, has been employed. The change is indeed most obscure; the author of the article on Photography in Watts's "Dictionary of Chemistry" says of it, "The atoms have apparently acquired a certain degree of mobility, in consequence of which, when submitted to the action of reducing agents, such as ferrous sulphate or pyrogallic acid, they suffer decomposition, the silver being reduced to the metallic state, and forming an opaque metallic film on the parts of the surface which have been exposed to light."

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[*] For equal proportions of nitrogen, oxamide produces half as much effect as urea, and oxalate of ammonia half that of sal-ammoniac. When I treat of the actions of salts and derivatives of aniline, I will give the cause of this difference.

[†] A paper read before the Royal Society.

[*] "Sur la propriété que possède l'iodure d'argent de se contracter par la chaleur et de se dilater par le froid," Comptes Rendus, 1867.

[†] I must express my indebtedness to Mr. Valentin for allowing me to have a quantity of iodide prepared at South Kensington.

The following experiments were made to determine the degree of sensitiveness of the iodide to light:—

α. By means of a large lens the rays of the electric lamp were brought to a focus within a glass cell containing a solution of iodide of potassium; a solution of nitrate of silver was then introduced by a pipette at the apex of the cone of rays. The precipitated iodide possessed its usual pale yellow colour.

β. Freshly precipitated iodide in suspension, with a slight excess of iodide of potassium, remained in the full glare of a July sun without undergoing any perceptible change; neither did it subsequently darken.

γ. Freshly precipitated iodide in suspension, with a slight excess of nitrate of silver, underwent no immediate change on exposure to a July sun. At the end of an hour it had become slightly grey, and subsequently darkened.

δ. Organic matter in the shape of starch-paste did not induce any change when mixed with freshly precipitated iodide in suspension with a slight excess of iodide of potassium. Albumenised paper with iodide precipitated upon it did not undergo any immediate change.

ε. Some dried and powdered iodide was found to have acquired a slight greyish metallic tinge after an hour's exposure to the sun. A freshly broken surface of fused iodide became very slightly darker after exposure to the sun. A very pale microscopical crystal of iodide, removed from the interior of a crystalline mass, became slightly brown after several hours' exposure to diffused light.

ζ. Crystals of iodide of silver produced by direct solution of silver in hydriodic acid were not affected by light; neither were crystals of hydro-argentic iodide ($\mathrm{Ag\,IHI}$), nor crystals of argento-potassic iodide ($\mathrm{Ag\,IKI}$).

θ. A sheet of silver leaf was exposed to the vapour of iodine (produced by spontaneous evaporation) for five minutes; it possessed a faintly yellow tinge, which on exposure to the sun instantly became pale green, but on further exposure returned to its original pale yellow. A second sheet was exposed for ten minutes to the vapour of iodine; it acquired a golden-yellow surface, which on exposure to diffused light acquired a purplish-red colour, and on exposure to the sun became greenish purple. On continued exposure this colour disappeared, and the plate returned to almost the original yellow colour.

ι. A sheet of silver leaf was exposed to the vapour of iodine for half an hour, at the end of which it possessed a decided golden-yellow colour; on exposure to the sun it instantly acquired a dark purple colour, edged with green at those parts least exposed to the direct vapour of the iodine. On continued exposure the purple became paler, but the sheet did not return to its original yellow colour.

κ. A developing solution composed of ferrous sulphate, alcohol, acetic acid, and water, when applied to the exposed sheets of θ and ι, which had been purple, but on continued exposure nearly regained their original colours, produced a reddish-brown colour.

λ. A sheet of silver leaf was exposed to the vapour of iodine for many hours; it was found to be converted into a slightly coherent film of lemon-yellow iodide. Light had no effect upon it, even after long exposure to a July sun; neither was any colour produced on the addition of a developing solution.

The pure iodide of silver would thus appear to be scarcely affected by light, except when silver is present, either in the form of nitrate, or as in the case of the silver films, as metallic silver.

If the precipitated iodide of silver be fused it is found to cool to a greenish-grey mass, which in thin layers is translucent. The surface has sometimes a dark steel-grey, semi-metallic appearance, but this does not affect the composition. Sometimes, without any apparent cause, the ordinary greenish surface and the dark steel-grey may exist side by side in the same fused mass. A second fusion may produce a uniformly greenish surface, or a uniformly steel-grey surface. But whatever the appearance of the fused mass, it always furnishes when pulverised a lemon-yellow powder, which, when heated, remains unaltered in colour up to about 105° C. (221° F.). At that temperature it begins to darken, and between 105° C. and 180° C. (356° F.) it assumes darker and darker shades of yellow, passing into orange and orange-red; above 180° C. it becomes decidedly red, and darkens through temperatures which may be roughly indicated by the fusing-points of tin, lead, and zinc, until at the latter temperature (412° C., 773° F.) it possesses a very dark brick-red colour. At this temperature the powder becomes coherent, but does not commence to fuse. At a somewhat higher temperature, probably about 450° C. (842° F.), the iodide fuses to a dark-red liquid, the colour of bromine, or of melted sulphur shortly before its boiling-point. At a red heat the iodide begins to volatilise and to decompose, and at a bright red heat this takes place readily. If the iodide be fused and poured into cold water, it becomes a lemon-yellow, amorphous, very brittle mass.

If the fused mass of iodide is allowed to cool, it solidifies to a dark-red transparent body, which is somewhat plastic. On further cooling it becomes much paler in colour, still remaining transparent; and if cooled as a thin film in contact with a hot surface, it passes to a pale yellow transparent variety. The transparent varieties, at a temperature which varies with the mass of the substance, and which in the case of a thin film may be as low as 105° C., become crystalline, opaque, and of a pale greenish-grey colour, somewhat brittle, and of a granular fracture. At the moment of the change from the amorphous, transparent, plastic variety to the opaque, brittle, crystalline variety, considerable expansion takes place, often accompanied by a loud cracking, and large fissures appear in the mass.

Many attempts were made to determine the precise temperature at which the change from the amorphous to the crystalline condition takes place; but the results were somewhat discordant, depending apparently on the mass of the iodide, and perhaps on the number of times it had been previous fused. The iodide was fused in a glass tube or porcelain crucible, and when fusion was quite complete was placed in an air-bath at 150° C. (302° F.), and allowed to cool. The exact temperature at which the tube was broken by the expanding mass was noticed. About 15 grammes of iodide, which had been often fused, changed suddenly from the amorphous to the crystalline condition at 120° C. (248° F.). Another specimen cracked the tube at 116° C. (240·8° F.). A porcelain crucible containing 10 grammes of the fused iodide commenced to change at 118° C. (244·4° F.); the crucible was violently riven open at 105° C. Two small test-tubes, about 6 millimetres diameter and containing 2 grammes of iodide apiece, were placed in the hot-air bath; the two masses of iodide simultaneously changed to the crystalline condition at 109° C. (228·2° F.). On one occasion a small mass weighing 3 grammes, prepared by dissolving silver in hydriodic acid, was fused in a tube and slowly cooled. It cooled down to the ordinary temperature of the air without breaking the tube; on moving the tube, however, the mass suddenly underwent molecular change, and the tube was broken. The same iodide fused with some which had been similarly prepared suddenly changed to the crystalline variety at 121° C. (249·8° F.). From the above results we cannot be far wrong in stating that the change from the amorphous to the crystalline variety of the iodide takes place at a temperature of about 116° C. (240·8° F.).

Presumably heat is evolved when the amorphous modification of the iodide passes into the crystalline. Several attempts were made to ascertain this by plunging a mass of hot amorphous iodide into hot mercury, inserting a thermometer, and allowing the whole to cool, but no rise of temperature was observed at any given point of the cooling.

If the fused iodide be cast into a tube of porcelain or brass the following effects may be observed:—(*a*) The mass contracts considerably at the moment of solidification, the level liquid surface sinking into a deep conical depression when it becomes solid. (*β*) For many seconds after the solidification the solid cylinder of iodide will freely slip out of the tube, and is then seen to be red and transparent, in fact in the amorphous condition; but (γ) if the mass cools until it assumes the crystalline condition it can no longer be got out of the tube; and if the latter be of glass or porcelain, it is infallibly broken by the expansion.

Hence if a mass of iodide be allowed to cool in the tube which it cannot break when it expands, it may be made to contract and slip easily out of the tube by heating it. Hence, also, as the change from the amorphous to the crystalline condition takes place at 116° C., it would appear that between the point of fusion, 450° C. and the temperature at which the amorphous iodide becomes crystalline, it follows the ordinary law and contracts as it cools, while below that temperature (and as will be shown as low as −18° C. (−0·4° F.) it expands on getting cooler, and possesses a negative coefficient. It thus appears that when the iodide is in the amorphous condition at 116° C., immediately before the change to the crystalline condition, it is at its point of maximum density.

Several unsuccessful attempts were made to burst metal bottles, after the manner of the familiar ice-experiment by the expansion of the iodide at the moment when it passes from the amorphous to the crystalline condition. On one occasion, when a somewhat large cylindrical mass had been cast into a tube of thin brass, the latter was burst by the expanding iodide, but thick metal bottles, furnished with a screw, which was forced down into the molten mass, were not broken. Thick porcelain and glass tubes were invariably broken by the expansion, and a good lecture experiment to illustrate the anomalous expansion is furnished by the following means. Let 20 or 30 grammes of fused iodide be cast into a thick cylindrical tube of porcelain a centimetre diameter; in the course of a minute or two the mass has cooled down to the temperature at which it changes from the amorphous to the crystalline condition; it then expands, cracks the tube with a loud noise, and sometimes jerks portions of the tube to a distance of several feet.

A curious effect was noticed in the case of bars of the iodide during cooling. If a bar be cast in a tube and pushed out before it begins to expand, it is seen to curve considerably during cooling. In the case of a bar 15 centimetres long by 6 millimetres diameter, the curvature was such as would be produced with a radius of 48 centimetres, and was always the same with bars of the same length and diameter. A very slight pressure resisted the tendency of the bar to curve. The effect was not due to conduction of heat from one part of the bar, while the rest remained perfectly hot; for the effect was the same whether the bar was allowed to cool on a flat copper plate, in an air-bath, or even if it were suspended by a thread of non-conducting matter. It takes place when the iodide passes from the amorphous to the crystalline condition, and is no doubt due to the inequality of strain produced between the outside portions which first become crystalline and expand, and the internal portions which assimilate the change less rapidly, for the iodide is a very bad conductor of heat.

(To be continued).

ON THE

EVOLUTION OF HEAT DURING THE HYDRATION OF CLAY-SLATE, CLAY, AND COAL.

By WILLIAM SKEY.

HAVING announced, in November, 1871,* that clay-slate hydrates when in contact with water, as shown by the coagulation test I devised, I have been desirous to obtain corroborative evidence in support of this statement, and so prosecuted the matter further; and being under the impression that the hydration of this substance would evolve heat, I ground some clay-slate to a very fine powder and put it to a small quantity of distilled water, when an elevation of temperature occurred in the mixture equal to about 2° F. above the temperature of the materials used.

To make sure that none of this rise was due to heat generated during the act of crushing and retained in such a manner, that the exact temperature of the powdered substance could not be ascertained, I repeated the experiment, but with this variation—the crushed slate was bottled off and not used till 24 hours afterwards. The thermometric results were the same.

The water after the mixing was slightly alkaline, owing no doubt to the presence of a minute quantity of alkalies derived from the slate, to the hydration of which or their compounds a part of the elevation of temperature noticed might have been due. To obtain, therefore, some indication of the quantity of this, I crushed some glass to quite as fine a powder as I had the slate instanced, allowed it 24 hours to cool (as I may state here I have for all succeeding experiments upon substances dried by heat), and then mixed it with water in same proportions as observed for the slate, when an elevation of temperature barely equal to 1° F. occurred. The water was of course strongly alkaline directly after the mixing was performed; clearly, therefore, the alkalies of the slate had no important share in producing the elevation of temperature observed.

At this stage I struck aside a little to experiment upon coal, clay, and other substances, in the hopes of obtaining facts extending over a wider field, and so capable of being handled more correctly and with greater ease, and I found carbonate of lime, as also quartz and brown coal or clay, did not give any indication of an evolution of heat when mixed with water; steatite, however, and anhydrous coal, also hydrous coal, clay, and lignen, when dried gently or wholly, did so.

Steatite had as much heating power as slate, while all the remaining substances cited were superior to it in this respect.

In the case of naturally anhydrous coal, or hydrous coal and clay dried at from 90° to 212°, or over desiccating substances (at common temperatures), I frequently obtained a rise of temperature from 3° to 6° F.

These results tend to show that, as a general rule, any so-termed hygroscopic substances, when deprived of even the smallest portion of their water, and then allowed to regain this by giving them contact with water, generate heat.

It will at once appear that, if in place of submitting water to these dried substances we submit aqueous vapour, the evolution of heat would be much greater, or would last longer, and in fact I find that these substances desiccated and exposed to common air rise in temperature very notably.

It only remains now to consider how much of this elevation of temperature is due to mechanical, and how much to chemical agency.

It is obvious a portion of this is due to friction, occasioned by the rapid inrush of water to the pores of these substances.

I believe the calorific effect of such inrushes has not yet been measured, if indeed noticed before, and in all likelihood they will be deemed so small as to be barely perceptible, or at most not at all necessary to take into account in determining the origin of the increase of temperature instanced, but as I felt anxious to get the approximate calorific result due to chemical agency, I have made an attempt to get at this by comparative tests.

In this attempt I substituted other liquids for water liquids which, experimentally, I found had no action upon the solids used, or only to a very minute extent.

My results were as follows: –

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* "Proceedings of New Zealand Institute," vol. iv., p. 381.

I. Clay-slate mixed with water raised a thermometer placed in the mixture 2° F. above the temperature of these substances, just before mixing them. A portion of the same sample of clay-slate, and in quantity as before, mixed with pine kerosene in same volume as that of the water used, only raised the thermometer 1¼° F.

II. Dried brown coal, similarly treated, gave an elevation of temperature equal to 4° F. with water, and only 2° F. with oil. The same conditions were observed as to quantities and volumes as in the first expriment.

As the kerosene used would have a less specific heat than water, the amount of heat due to friction in the first experiment would not be *so much as* 1¼°, and in the second experiment not *so much as* 2°, leaving a balance of heat equal to something more than ¾° and 2° F. for the slate and coal respectively, which balance is, I conclude, due to chemical action, and as I believe kerosene is more diffusive than water, and so would rush these substances with greater rapidity than water would, thus producing more friction, the balance of heat found is, perhaps on this account, again less than the actual amount due to chemical action.

Returning now to the subject I started with, the supposed direct hydration of clay-slate by water, and bringing results just stated to bear upon this question, it certainly appears that this substance evolves heat when mixed with water, which heat is the result of *chemical action*, and the only agency to which I can attribute this chemical action is the hydration of the clay-slate used.

Thus the statement hazarded as to the direct hydration of clay-slate by water receives support upon the ground I have just traversed.

Applying now the facts just elicited in a general manner, it appears—

(1). That in the disintegration of rocks or soils heat is evolved.

(2). That the differences in temperature sometimes observed between contiguous strata may be due, wholly or partly, to this cause.

(3). That our native anhydrous coals hydrate upon their surfaces when exposed to water or aqueous vapour.

(4). That hygroscopic water is chemically-combined water.

(5). That the quantity of water present in certain rocks or minerals may, when known, frequently indicate the highest temperature to which they have been subjected.

(6). That the bulk of vegetable matters (leaves, twigs, &c.) generally develope heat by hydration, also by friction, when the temperature of the air surrounding them is lowered.

In regard to these statements it requires, in the case of (3), gravimetrical experiments to support it, which I shall presently endeavour to obtain, and if they should prove it a correct one, that is, that anhydrous coal can hydrate and to any notable extent, it will certainly appear that these substances have been formed at a somewhat elevated temperature, perhaps approaching to nearly 100° C.

While upon the subject of the formation of coal, I would just like to observe here, that I cannot avoid thinking the effects of pressure in consolidating this, and indeed other minerals, also rocks, has been considered much greater than they really have been or are now, and this because it seems that these subjects will generally, if not always, be charged with water, oil, or gas, and, if this is so, I conceive the consolidating action of pressure would be very greatly mitigated, and would be in some proportion to its actual volumetrical effect upon the liquid receiving it. I cannot see how particles suspended, or thoroughly soaked with a liquid, can be made to approach each other by pressure, except by allowing the liquid to escape, and it does not appear, in the case of rocks, &c., at some depth, that there can be any such way of escape, at least a sufficiently ready one for the liquids or gases lodged in their pores.

In reference to the statement (4) that the hygroscopic water of substances retaining it is combined water, this appears certain from what has been described, and also from other considerations. Thus, to take an analogous case, the salt chloride of silver forms a definite crystallisable chemical compound with ammonia, but, though acknowledged as such, it can only be preserved in an atmosphere of ammonia, and if this gas is taken away as evolved, the mineral loses the whole of it, even at common temperatures; if this was not obviously a definite mineral we might have extended the meaning of the term hygroscopic, given it a general application, and styled the ammonia thus retained *hygroscopic*. Now I conceive water has relations to the so-termed hygroscopic substances, similar to those ammonia sustains to argentic chloride; it chemically combines with these substances, and the compounds thus formed are not permanent, except at a temperature not higher, and a tension of aqueous vapour not less, than that at which they were produced.

Lastly, as to a production of heat by the chemical combination of water with the substances of plants, a combination brought about by changes in the temperature of the air, or in the tension of its vapour, this is no doubt a very useful provision for preventing sudden atmospheric changes of this nature affecting the vegetable world abruptly.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 17th, 1874.

Professor J. H. Gladstone, F.R.S., Vice-President, in the Chair.

The minutes of the preceding meeting having been read and confirmed, Mr. F. B. Benger was formally admitted a Fellow of the Society. The names read for the first time were those of Messrs. R. E. H. Goffin, W. Armstead, M.B., W. McCowan, J. W. Biggart, and D. Johnson. Messrs. Edward Wethered, William Henry Symons, William Wade Hyde, James Alfred Kendall, David Bendix, John McDougall, Henry Penley Harris, and Edward Sonstadt were balloted for and duly elected, after their names had been read for the third time.

The first paper, "*On Groves's Method of Preparing Chlorides*," by C. Schorlemmer, F.R.S., was read by the Secretary. The author finds that, on passing hydrochloric acid into a boiling mixture of heptylic alcohol and zinc chloride, pure heptylic chloride is not produced, but a mixture of heptenes with both the primary and secondary heptylic chlorides. Amylic alcohol treated in a similar way yields the primary and secondary amylic chlorides mixed with some diamyl ether. These results, the author believes, explain the peculiar action of zinc chloride; the alcoholic chlorides being produced by two distinct reactions, one part by the union of the acid with the olefine in the nascent state, and the other by the direct action of the acid on the alcohol.

Mr. C. E. Groves said it was not difficult to give a hypothetical explanation of the production of the alcoholic chloride, but it must be remembered that the distinctive action of zinc chloride was the *complete* conversion of the alcohol into the corresponding chloride, and the *perfect* absorption of the hydrochloric acid during the reaction. It did not seem to him that Dr. Schorlemmer's hypothesis satisfactorily accounted for this.

Mr. E. Neison remarked that, if secondary octylic alcohol were heated with zinc chloride, it was almost completely converted into octylene, and when hydrochloric acid is passed into the pure boiling alcohol very little octylic chloride is produced; the simultaneous action of zinc chloride and hydrochloric acid, however, rapidly converted 70 to 80 per cent of the alcohol into the chloride. In the case of ethylic alcohol, although zinc chloride alone does not reduce it to the olefine, the simultaneous action of hydrochloric acid enabled it to do so, combining with the nascent olefine to form ethyl chloride.

The Chairman having thanked the author,

A note "*On the Precipitation of Metals by Zinc*," by J. L. Davies, was read. The author finds that zinc does not precipitate nickel, cobalt, or iron from acid solutions, but the two first are readily precipitated from ammoniacal solutions, and iron to a considerable extent in solutions containing salts of ammonia.

Mr. W. H. Walenn said that the addition of ammonia enabled zinc to precipitate iron in the metallic state; he had also observed that zinc would precipitate brass from a cyanide solution containing ammonium tartrate.

Dr. Gladstone remarked that Dr. Russell had called the attention of the Society to the fact that, in precipitating a solution of copper by zinc, the former metal was found to contain a very large amount of zinc. This was explained by the secondary reaction which takes place, the zinc salt produced being decomposed by the voltaic current formed by the two metals.

Papers entitled "*Researches on the Paraffins existing in Pennsylvanian Petroleum*," by T. M. Morgan, and "*Some Remarks on the Preceding Paper*," by C. Schorlemmer, F.R.S., were then read.

Mr. Morgan finds that normal hexane boiling at 68° to 70° C., when chlorinated, yields a mixture of mono-chlorides, boiling at 120° to 134° C. Alcoholic potash converts about two-thirds of this into olefines boiling at 68° to 70° C. By treatment of these olefines with hydrochloric acid in the cold, a part was converted into the chloride. Potassium acetate decomposed this, with regeneration of hexene. The alcohol obtained from this, by combining it with hydriodic acid, decomposing the product with lead acetate, and finally treating the hexyl-acetate so obtained with alcoholic potash, boiled at 125° to 129° C., and had the odour of peppermint. The hexene, which was unattacked by hydrochloric acid in the cold, was found to yield an alcohol boiling at 132° to 137° C.; from the products obtained by its oxidation, it appears to be methyl-butyl-carbinol. The normal heptane from the same source, boiling at 96° to 99° C., when chlorinated and submitted to processes resembling those above mentioned, yields two alcohols, boiling at 140° to 141° C., and at 155° to 158° C., respectively. The latter is the methyl-pentyl-carbinol already investigated by Schorlemmer.

Dr. Schorlemmer thinks that, from Mr. Morgan's experiments, it is probable that Pennsylvanian petroleum contains, besides the normal heptane and the isomeride boiling at about 90° C., a third isomeric hydrocarbon. It is possible, however, to explain the author's results in another manner. In order to decide the question, it will be necessary to use an absolutely pure paraffin; that which appears to be best adapted for this purpose is the normal hexane from mannite. The author intends to examine this point very carefully, and also to study the derivatives of normal octane prepared from methyl-hexyl-carbinol.

The Chairman having thanked the authors in the name of the Society,

Mr. D. Howard read a note "*On Aricine.*" Hesse, in his paper "On the Cinchona Alkaloids, refers to the very unsatisfactory state of our knowledge of aricine, the very existence of which he is inclined to doubt. The author, however, believes the cause of this is, that barks containing aricine, which were plentiful in commerce at the time when Pelletier and Winkler wrote on the subject, being valueless, have ceased to be imported. A quantity of aricine-yielding bark still existing in the collection of Mr. J. E. Howard was, however, placed at the author's disposal, and he finds, besides kinic acid and quinovine, that it contains a yellow colouring matter, and the alkaloid aricine, whose properties and chemical reactions are quite distinct from quinine, quinidine, cinchonine, cinchonidine, quinamine, quinicine, and cinchonicine. It gives a specific rotary power of 63° to the left for the yellow ray. The quantity of alkaloid was too small to enable the author to determine its composition.

In reply to a question of Dr. Gladstone,

Mr. Howard said that, besides the well-defined group of alkaloids, quinine, quinidine, quinicine, cinchonine, cinchonidine, and cinchonicine, there were four others occurring in reputed cinchona barks, viz., paytine, paricine, beerberine, and aricine, which appear to form a group apart. It was a point of great interest, both botanically and chemically, to ascertain whether these occurred in any of the true cinchonas. Nothing was at present known on this subject.

The Chairman, having thanked Mr. Howard, announced that Professor Clerk Maxwell had promised to give a lecture, on the 18th of February next, "On the Dynamical Evidence of the Molecular Constitution of Bodies."

The meeting was then adjourned until Thursday, 17th of January, 1875.

NOTICES OF BOOKS.

Inorganic Chemistry: Theoretical and Practical. First Course. By T. Jamieson, F.C.S. Aberdeen: Free Press Printing Company.

Were our higher chemical literature, and especially our original researches, at all proportioned in quantity to the amount of elementary chemical works issued from the British press, our position would be high indeed. The number of manuals, handbooks, epitomes, and lecture notes that have appeared, and are still appearing, is great indeed. None of these productions can be pronounced worthless. As a rule they give a correct account of established facts and of temporarily-established theories. Each of them can scarcely fail to have, in some point or other, the advantage over its rivals. But for all this we are often sorely puzzled to find any valid plea for the existence of the majority. Until some novel leading fact shall be established, or some really valuable generalisation attained, we could wish that the authors of such would works would pause.

The volume before us treats of seven of the non-metallic elements only, whence we must conclude that further parts are in course of preparation. The work may undoubtedly claim the merit of clearness. Marginal notes furnish a running summary of the text, and will greatly assist the student in recapitulating. The experiments to be made, the results observed, and the inferences to be drawn are arranged in parallel columns. The book is also interleaved with blank writing-paper, so that the student may note down anything of importance heard or seen at lectures. In short, whatever can be done by the aid of judicious arrangement, by the use of varied type, by tabular and graphic representation, to give the highest prominence to what is of the greatest importance, and to fix it in the mind of the student, hoping that it may by the principle of association recall the secondary matter, has been done here. This is, we believe, all that the author claims. The work, as he himself tells us, "contains no new fact, and presents no originality, beyond that of expression, arrangement, and illustration." He writes, indeed, for students seeking to "pass" the examinations of the Department of Science and Art, a circumstance which appears to have given a certain bias to his teachings, from which we should be glad to see him freed. As a consequence of that bias he sometimes advances views which are not incapable of being controverted. The present brief notice is not, however, the place for entering upon such a discussion. We will merely say that, whilst his shortcomings are those of the school he represents, his merits are indisputably his own.

Five Hundred Chemical Experiments for One Shilling. Arranged for Young Beginners in Chemistry. By F. Moutier. London: Townson and Mercer.

The author tells us in his preface that "a want has been felt which the following Five Hundred Chemical Experiments is designed to meet." The nature of the work may be sufficiently understood from the title. We are bound to admit that, generally speaking, correct instructions are given for the performance of the experiments, and the lesson to be learnt from each is made sufficiently clear. In a few cases we should be disposed to say, repeating the well-known advice of Punch to persons about to marry —"Don't." The preparation of iodide of nitrogen is hardly adapted for young beginners. The development of hydrofluoric acid in a leaden tray eight inches square, is likewise quite unfit for any ordinary room. Under a draft-hood, or in the open air, it may be attempted in safety.

We read under experiment 165, that "the foul smells from drains may thus be destroyed: hence chlorine is a disinfecting agent." We submit that to deodorise and to disinfect are by no means convertible terms.

In experiments 358 and 359 we are told that chrome-red is made by adding solution of lead acetate to potassium dichromate, whilst if the neutral chromate is employed, the result is chrome-yellow. This is by no means correct; chrome-yellow is ordinarily made with the dichromate, whilst chrome-red may be obtained by grinding up litharge with a little strong potash lye and then adding, in the cold, one-quarter of its equivalent of dichromate. To the above, and a few other oversights, we would beg to call the attention of the author in case of a second edition.

Taken as a whole, however, the work may be described as by no means ill-calculated to answer its purpose.

Fibrin and White or Colourless Corpuscles: their Nature and Origin in the Animal Organism. By J. Goodman, M.D. Edinburgh: J. Lindsay.

The author describes, in this pamphlet, the production of fibrin from the serum of blood, by the agency of water. Egg albumen, also, if immersed in cold pure water, and exposed for some little time to its influence, loses the characters of albumen, assuming the nature, appearance, and constitution of fibrin. It is necessary for the success of these experiments that the egg albumen should not be old, nor the blood serum long drawn. If these precautions are neglected, or if the water employed be close upon the freezing-point white corpuscles appear, instead of fibrin. The "fibrinised" egg, or artificial fibrin, has been recommended as one of the most easily digestible ailments known. For this purpose an egg is stripped of its shell and plunged in at least a pint of cold water, where it is suffered to remain for at least twelve hours. The water is then raised to a boil.

The Safe Use of Steam; containing Rules for the Guidance of Unprofessional Steam Users. By An Engineer. London: Lockwood and Co.

A marvel of practical instruction for the arrangement of steam-boilers. Were the precautions here laid down duly attended to, we should be far less frequently pained by the account of a boiler explosion and its attendant massacre.

Journal of the Society for the Promotion of Scientific Industry. April, 1874. Manchester: Published by the Society.

This number contains the opening address of the President, Earl Derby, and a paper by Mr. Lowthian Bell on the economical consumption of fuel.

CORRESPONDENCE.

ASSAY OF LEAD.

To the Editor of the Chemical News.

Sir,—I think the following process for the management of the assay of lead in ores will be found convenient, particularly where, as is often the case, the lead to be estimated is mixed as sulphate with the matrix insoluble in acid.

I dissolve the sulphate or chloride as the case may be in acetate of ammonium, make the solution as neutral as possible, and estimate the lead by a standard solution of bichromate (a half decinormal solution answers well) with a nitrate of silver indicator.

There is nothing very new in any particular point of this method, only I think the volumetric estimation of lead-sulphate dissolved in ammonium acetate by the bichromate has not been yet applied, and, as it shortens labour, enables the insoluble matrix to be weighed direct after drying, and gives accurate results, I think well to mention it.—I am, &c.,

F. Maxwell Lyte.

6, Cité de Retiro, Faubourg St. Honoré.
Paris, December 16, 1874.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

Sir,—In reply to Mr. Murphy's letter (Chemical News, vol. xxx., p. 282). I have to repeat that in my experience the most reliable results were obtained by oxidising the the sulphur in the char itself. If Mr. Murphy received a sample of ferrous sulphide for analysis (a commercial sample), I presume he would not apply the evolution method for the estimation of sulphur. As applied to char, in my opinion it would be deceptive and misleading. But I will not take up space discussing such a question.

Mr. Murphy fancies that the calcium sulphides must be heated to their melting-points before they would part with their sulphur to iron. Again, I ask Mr. Murphy to try the experiment. He will find a very low red heat quite sufficient to obtain spongy ferrous sulphide from a mixture of calcium sulphides and reduced iron.—I am, &c.,

R. Frazer Smith.

ESTIMATION OF FIXED OIL IN ADULTERATED CITRONELLE.

To the Editor of the Chemical News.

Sir,—The following are the details of a process for estimating the amount of "fixed oil" in adulterated citronelle, which in the absence of information in available books, I was obliged to devise recently. This method yields constant results when managed with care, and when taken in conjunction with the specific gravity of the sample may give a good approximation as to the quantity and the class of the adulterating oil. I should be very glad to be instructed by having possible errors in the process pointed out, or to be put in the way of finding a better one.

A. Dissolve about one ounce of caustic potash in five ounces of alcohol in a flask; put on a sand-bath, and leave to boil.

B. Tare an 8-oz. beaker and weigh into it 400 to 500 grains of the citronelle; add two volumes of alcohol; boil on a sand-bath.

C. When A and B are both boiling, add one volume of the alcoholic solution of potash to the three volumes of alcohol and citronelle. Boil for a minute or so and then fill to within an inch of the top with distilled water. Stir gently, and let boil for about half an hour or until the upper layer is perfectly clear, and the under-fluid semi-transparent. Then allow to cool.

D. When quite cold, syphon off the under-fluid (containing water, alcohol, and potash, and *soap* if any fixed oil was in the sample) very carefully into another beaker and boil gently. Acidify with dilute H_2SO_4. Add 50 or 100 grains of wax, continue gently boiling till the oily layer is perfectly clear, and then allow to cool gradually.

E. When cold remove the cake of fat, dry, and weigh. The weight, less 50 or 100 grains of wax, is the amount of fatty acid contained in the fixed oil. A simple calculation will show the amount per cent of the adulterant in the citronelle.—I am, &c.,

T. A.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—Having recently had occasion to doubt the accuracy of a rather unknown (in the commercial world) analyst, we submitted a portion of the original sample to a third chemist; results enclosed. A. and B. are the original tests; C., result of B.'s duplicate, showing a difference of nearly 4 per cent—in other words, a loss of £100 on the cargo. It is, indeed, high time some steps were taken to prevent these frightful discrepancies.—We are, &c.,

Pickford & Winkfield.

148½, Fenchurch Street, London, E.C.,
December 9, 1874.

A.		B.	
Moisture	2·96		5·63
Undetermined	2·32	Water of hydration	7·19
*Phosphoric acid	32·16		30·86
Lime	49·61		40·58
Oxide of iron Alumina, magnesia, &c., not determined	2·95	Oxides of iron and alumina	5·32
†Carbonic acid	7·25		3·28
Insoluble matter	2·75		2·66
		Sulphate, fluoride of lime, magnesia	4·48
	100·00		100·00
*Equal to tribasic phosphate of lime	70·22		67·27
†Equal to carbonate of lime	16·47		7·45

C.

Moisture	3·40
Water of combination	4·65
*Phosphoric acid	32·59
Lime	45·75
Oxide of iron Alumina, magnesia, &c., not determined	4·03
†Carbonic acid	6·63
Insoluble matter	2·90
Undetermined	0·05
	100·00
*Equal to tribasic phosphate of lime	71·15
†Equal to carbonate of lime	15·06

DEODORISING OILS.

To the Editor of the Chemical News.

Sir,—Some little time ago I addressed a query to you asking whether any of your subscribers could give me information of how to efface or drown the smell of petroleum or paraffin oil.

These oils would be of great use to the medical profession for outward applications if the disagreeable odour could be got rid of.—I am, &c.,

W. Hughes.

2, Abingdon Road, Kensington.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 21, November 23, 1874.

Recent Improvements in Electro-Magnetic Machines.—M. Z. T. Gramme.—The author announces that he has constructed one machine for the electric light, two for galvano-plastic, and some small machines for scientific demonstration. The machines for demonstration can heat to redness 0·10 metre of platinum wire of 3-10th millimetre in diameter. Those at present made in the workshops of M. Breguet, and in the author's own, redden 0·40 metre of the same wire (*i.e.*, four times more than the former) without any variation, either in the weight of material or in labour. This increase in the intensity of the current is mainly due to the new foliated magnets of M. Jamin. One of the galvano-plastic machines has been working for two years, to the entire satisfaction of the purchasers. It has required no repairs, and no outlay beyond greasing the axle. Some of the author's machines deposit 0·6 kilo. of silver hourly. The new galvano-plastic machines have only one central ring in place of two bars of electro-magnets in place of four. Like its predecessors it deposits 0·6 kilo. of silver hourly, but the force required for its motion is only 50 in place of 75 kilogrammetres. It requires less space by one-half; its gross weight is reduced three-fourths; the copper required in its construction is also reduced three-fourths, and it economises 30 per cent of motive power.

Saccharine Matter Contained in Mushrooms.—M. A. Muntz.—In former researches (*Comptes Rendus*, lxxvi., p. 649) the author has shown that mushrooms contain saccharine matter in the form of mannite, of trehalose, or a glucose of a species not determined. The part played by this sugar in the life of the plant is very important. It is the form through which the carbon commonly passes both in approaching and in departing from the maximum of oxidation. This circumstance has led the author to examine the lower fungi which play the part of ferments and moulds. In the true ferments, such as beer-yeast, he has not been able to prove the presence of mannite and trehalose. The moulds, on the other hand, have yielded the bodies in question very distinctly. *Penicillium glaucum*, cultivated in solutions of starch, inverted sugar, tartaric acid, and gelatin, to which the needful mineral elements were added, contained constantly in its tissues a very appreciable quantity of mannite. The production of mannite at the expense of the elements of tartaric acid deserves attention. The constitution of these two bodies differs widely. The molecule of tartaric acid is more simple, and contains a less quantity of equivalents of carbon. The *Penicillium*, therefore, effects a true synthesis, in a manner accessory to its principal function, which is a complete combustion, the reverse of the synthetic function, which is more characteristic of the plants containing chlorophyll. *Mucor mucedo*, cultivated on horse-dung, putrescent kidney-beans, &c., yielded trehalose, but no mannite. In this respect, the moulds rank with the higher fungi. The myxomycetes are placed by some authorities between animals and plants, and by others among the fungi. It was, therefore, interesting to examine what sugar they contain. *Ethalium septicum* yielded abundance of trehalose—a fact which tends to connect these plants with the fungi.

Effects of Sulpho-Carbonate of Potassium upon the Phylloxera.—M. Mouillefert.—The experiments appear to have been successful where the quantity of water was sufficient to carry the sulpho-carbonate thoroughly into the soil.

Means Followed to Discover the Substance Most Effectual for the Destruction of the Phylloxera.—M. Max Cornu.

Experiments made on the Shoots of the Vine Plunged into Water Holding Various Substances in Solution.—M. A. Baudrimont.

Certain Facts Relating to the Phylloxera, to the Submersion of Vines and Corn; Application of Naudin's Process to Vines which cannot be Submerged.—G. Grimaud.

Influence of Temperature on the Coefficient of the Capillary Flow of Liquids.—M. A. Guerout.—The author shows that the coefficient of the flow of a liquid increases or decreases very rapidly, in consequence of a rise or fall of temperature. For a rise of 10° C., the coefficient of flow—in other words, the mobility of the liquid—is increased by one-third. This increase of mobility corresponds to a decrease of cohesion between the molecules of liquids, showing that when a liquid, on being heated to a sufficient temperature, is resolved into vapour, it is in consequence of the progressive weakening of the cohesion which binds its molecules together that this force is destroyed so as to permit vaporisation. This influence of temperature upon the mobility of liquid molecules is possibly felt in the flow of liquids through the capillary vessels of the organism. The action of cold, which is known to arrest circulation in the tissues, may be due, not to congelation, but to the partial destruction of the mobility of organic liquids.

Product of the Addition of Propylen to Hypochlorous Acid.—M. L. Henry.—Not adapted for abstraction.

Bulletin de la Societe Chimique de Paris,

Nos. 6 and 7, October, 5, 1874.

Determination of Tannin.—MM. Muntz and Ramspacher.—The principle of the method is as follows:—A solution of tannin, filtered by pression or aspiration through a piece of hide, gives up to it all its tannin, whilst the rest of the dissolved matters pass through the animal tissue. The authors have satisfied themselves by direct experiment that the matters which may accompany the tannin, such as saccharine and gummy substances, organic salts of potash, lime, magnesia, &c., are not retained by the hide. On evaporating to dryness equal quantities of the solution, filtered and unfiltered, and deducting the weight of the former residue from that of the latter, we find the exact weight of the tannin absorbed by the hide. As an example: 50 grms. of oak-bark, ground in a coffee mill, are exhausted with boiling water, so as to make up 250 c.c. of liquid. A piece of hide, free from hair, and previously softened in water, is stretched over a small zinc drum of about 0·06 metre in diameter, and secured in its place with a copper wire. The opposite end of the drum forms a tube, to which is attached a tube of caoutchouc from 1·5 to 2 m. in length, and terminating above in a funnel. Into this is poured the solution of the sample. The first 4 or 5 c.c. of the filtrate are rejected because they contain certain albumenoid matters expelled from the hide by displacement. After having thus collected by filtration a certain quantity of the liquid, 25 c.c. of the filtrate are evaporated to dryness at 100°, and also 25 c.c. of the unfiltered solution; we have then—

Weight of tannin and foreign matter ..	0·465 grm.
Weight of foreign matter alone	0·175 "
	0·290 "

being the weight of tannin present in 25 c.c. of liquor. The total volume of this liquor being known, and the amount of bark from which it is obtained, the percentage of tannin in the latter is found by a very simple calculation.

Phosphates of Sesquioxide of Iron and of Alumina.—M. Millot.—The author has obtained phosphates of sesquioxides of the following formulæ:—

$PO_5,M_2O_3nHO, - 3PO_5.2M_2O_3nHO2PO_5Mn_2O_3,nHO.$

Phosphate of sesquioxide of iron, $PO_5,Fe_2O_3,5HO$, is formed by pouring an excess of phosphate of soda into a salt of sesquioxide of iron, or by precipitating a solution of one of the following phosphates by an excess of acetate of soda. It is a white gelatinous precipitate, which, if dried at 100°, answers exactly to the above formula. If ignited it gives the anhydrous salt, $PO_5Fe_2O_3$, insoluble in acids, but attacked by alkalies. $3PO_5,2Fe_2O_3,10HO$.—Rammelsberg finds this phosphate to form cubic crystals, and has obtained it by setting aside for a year a saturated solution of the former salt. Large quantities of this salt may be obtained by treating oxide of iron with an excess of phosphoric acid, either in the cold or at a temperature of 100°. A little water is added, and the solution is filtered. A clear liquid is thus obtained, which, when mixed with water, deposits a little phosphate. The precipitation is much more complete on the application of heat. If the quantity of water is sufficient we obtain an abundant deposit, which towards 100° occasions violent projections. It is filtered whilst still boiling, and yields, after washing, the above compound. If the liquor is left to itself in the cold the precipitate re-dissolves in the course of a few days, but may be thrown down again by boiling. The same compound may be obtained by mixing 3 equivs. of acid phosphate of ammonia and 2 equivs. of sulphate of sesquioxide of iron, and heating the liquor to ebullition. On ignition it yields $3PO_5,2Fe_2O_3$, insoluble in acids, but attacked by alkalies. $2PO_5,Fe_2O_3,8HO$ is obtained by treating the foregoing with 2 equivs. of phosphoric acid, or by attacking oxide of iron, hydrated or anhydrous, with excess of phosphoric acid, treating with water to remove the dissolved substance, and repeating this procedure several times. The compound is obtained as residue. The oxide of iron, insoluble in concentrated acids and in aqua regia, is attacked by phosphoric acid in the cold, or at 100°. The salt, ignited, yields the anhydrous phosphate, $2PO_5,Fe_2O_3$, insoluble in acids, and attacked by alkalies. These three hydrated phosphates have properties very much alike. They lose their last equivalent of water between 170° and 180°, and become insoluble in acids. When hydrated they are very readily decomposed by salts. Oxalate of ammonia at the boiling-point, and the alkaline salts, and citrate of ammonia in the cold, dissolve them completely. They are insoluble in water and acetic acid, but become slightly soluble in the latter if mixed with salts of lime. (2) *Phosphates of Alumina*, $PO_5,Al_2O_3,5HO$.—This salt is prepared by precipitating sulphate of alumina with phosphate of soda, leaving the liquor decidedly acid, filtering, and drying at 100°. When ignited it yields PO_5,Al_2O_3, insoluble in acids, soluble in alkalies. $3PO_5,2Al_2O_3,20HO$.—This salt can only be obtained by dissolving alumina in phosphoric acid, and boiling the solution, when the phosphate is precipitated, carrying down with it a variable excess of alumina. The author has likewise obtained it by boiling 3 equivs. of acid phosphate of ammonia and 2 equivs. of sulphate of alumina in presence of a certain quantity of free sulphuric acid, which dissolves the excess of alumina. On ignition this salt yields $3PO_5,2Al_2O_3$, anhydrous, and insoluble in acids. $2PO_5,Al_2O_3,8HO$ is obtained by treating 1 equiv. of the former salt in the cold or at 100° with 2 equivs. of phosphoric acid. The insoluble residue is washed and dried at 100°. On ignition this salt yields $2PO_5,Al_2O_3$, insoluble in acids, but attacked by alkalies. This anhydrous compound is also formed by igniting a salt of alumina with excess of phosphoric acid, like the corresponding salt of iron. These phosphates have the same properties as the corresponding salts of iron, but their solubility in saline solutions is much greater. The phosphates of sesquioxides have the curious property of not dissolving immediately in concentrated acids, whilst they dissolve readily in the same acids on dilution if the time of action is prolonged.

On Isoterebenthen.—J. Ribau.—A description of this body, of its mono- and bi-hydrochlorate, and of its conversion into cymen. It appears to furnish the same cymen as terebenthen and tereben.

Isoterebenthen from a Physical Point of View.—J. Ribau.—The point of ebullition is 175°, or 20 below that of its isomers. Its rotatory power is, at 23° C.,—

	I.	II.
(α) j :	−9°, 17.	−9°, 72.

Its specific gravity ranges from 0·8586 at 0° C. to 0·7793 at 100°. Its index of refraction, at 25° C.,—

Ray.	Length of Wave.	Indices.
Red	0·00065618	1·4677
Yellow	0·00058920	1·4709
Green	0·00051739	1·4760
Blue	0·00044810	1·4839

Solid Polymer of Oil of Turpentine, Tetraterebenthen.—J. Ribau.—This isomer is solid, amorphous, brittle, of a pale yellow, quite transparent, of conchoidal fracture, and easily pulverised. It is easily rendered electric by friction. It is almost insoluble in alcohol, but soluble in ether, sulphide of carbon, benzol, petroleum, and oil of turpentine, from which it is deposited on evaporation as a colourless varnish. It turns the plane of polarisation to the right, [α]j = +20°. Its specific gravity at 0° = 0·977. It melts below 100°, and does not distil at 350°. Oil of turpentine yields with protochloride of antimony a characteristic red colouration.

Correspondence from St. Petersburg.—This consists of a brief notice of trimethylacetic acid and pivalic acid, by M. Boutlerow; of iodide of ethyliden, by M. Gustavson; and of the synthesis of dimethyl-isobutyl-carbinol, by M. Parlof.

Reimann's Farber Zeitung, No. 40, 1874.

Aniline Blacks.—The following mixture is given for cylinder printing:—1 k. 590 grms. chlorate of potassa; 1 k. 590 grms. sal-ammoniac; 1 k. 500 grms. moist sulphide of copper; 3 k. 600 grms. white starch; 23 litres of water. This is boiled, stirred until cold, and mixed with 3 k. 170 grms. "sublimed aniline salt," previously dissolved in 9 litres of cold water. It is then ready for use. The deficient intensity of aniline blacks generally arises from the circumstance that the colours are prepared with so-called "red oil," a residue of the manufacture of magenta, which contains various impurities.

The editor gives receipts for dyeing a black on half-woollen goods (cotton warps); a steam cochineal-red for cotton yarn and cloth; a fast methyl green upon woollen yarns, grounded with Nicholson blue; a silver grey, a ponceau and a brown on woollen cloth; a black for printing woollen yarns; an aniline blue for silk dyeing; a dressing for blue printed goods and muslins; a vat-blue on cotton, with a catechu gronnd; a blue-black on cotton velvet; and directions for printing red, white, and black on calico and muslin.

M. Gros-Renaud gives the following instructions for a fast puce with alizarin:—The mordant is an acetonitrate of sesquioxide of chrome, and may be used also along with logwood liquor for steam-blacks. It is prepared by placing a stoneware pan, of the capacity of 30 litres, either in the open air or in a roomy place. It is warmed, and 3 kilos. of coarsely pulverised chromate of potash are put into it, along with 4 litres 400 c.c. of boiling water, 2 lit. 600 c.c. of white glycerine at 28° B., and 4 lit. 280 c.c. of acetic acid at 7° B. When the chromate is dissolved, the liquid is poured into a copper pan fitted with a steam-jacket, heated to boiling and kept at that temperature, until it appears of a fine green if seen in a thin stratum. It is then poured into a stoneware vessel to cool, the liquid is then decanted off, and the deposit of nitrate of potash is washed with 800 c.c. of cold water, and the washings are added to the liquid. The mordant thus prepared is not sticky, and does not become turbid on mixing with water. When thickened it neither decomposes starch-paste, nor coagulates gum-water. One gramme of pure dry alizarin, natural or artificial, requires 5 c.c. of this chrome mordant at 30° B. For use, 1 litre of this mordant at 3° B. is thickened with 300 grms. of dark calcined starch. The pieces, after printing, are passed for one to two minutes through water containing 10 per cent. of ammonia, and dyed in the ordinary manner with dyewoods, extracts, or alizarin. For dyeing self-colours the pieces are padded in the mordant, dried, passed through ammonia water, washed and dyed.

The total monthly production of artificial alizarin in Germany amounts to 200,000 kilos., replacing one-third of the madder formerly consumed.

No. 41.

Dr. Freise announces that the manufacture of "patent colours" in Göttingen will shortly resume operations.

Freeing Wool from Burls by Chemical Means.—The substance of the process here described has already appeared in the Chemical News.

There are receipts for dyeing a Bismarck brown, a fast cherry-brown, and a maroon, on woollen yarn; for bleaching linen; for printing red and brown madder work on calico, and for dyeing "beider wend."

No. 42.

This number contains receipts for dying an olive on wool, a saffranin rose on cotton yarn and pieces; a chamois on garments (half wool), and a green printing colour for muslins. To detect cotton in linen tissues, Böttger, in *Dingler's Polytech. Journ.*, recommends a process founded on the fact that linen fibre, when steeped in an alcoholic solution of corallin, then dipped in a concentrated aqueous solution of carbonate of soda, and finally washed repeatedly with the soda solution, takes a fine rose colour, whilst cotton remains colourless. The sample of cloth must previously be freed from dressing.

NOTES AND QUERIES.

Metallurgical Query.—I have occasion to make bell-metal (alloy of copper and tin) red-hot, and in so doing would wish to infuse into it, by the vapour of the fuel used, bisulphide of carbon, to the exclusion of oxygen and hydrogen. Would any of your correspondents kindly inform me, as I know nothing whatever of chemistry, in what order the use of the following fuels would be likely to further my object? I should be satisfied if I could learn which one would be most likely; wood, charcoal, coke, and coal.—G. Potter.

MEETINGS FOR THE WEEK.

Tuesday, 29th.—Royal Institution, 3. "On the Voltaic Battery: the Cell and its Effects" (Juvenile lecture), by Professor Gladstone.

Thursday, 31st.—Royal Institution, 3. "On the Voltaic Battery: the Replacement of Metals" (Juvenile lecture), by Professor Gladstone.

Saturday, Jan. 2nd.—Royal Institution, 3. "On the Voltaic Battery: Electrical Decomposition" (Juvenile lecture), by Professor Gladstone.

TO CORRESPONDENTS.

⁂ Vol. XXIX. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxx. commenced on July 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

M. D.—Communication received. Accept our thanks.

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